ECLIPSE PHASE

PANOPTICON

Volume 1: Habitats, Surveillance, Uplifts

POSTHUMAN STUDIOS

ECLIPSE PHASE
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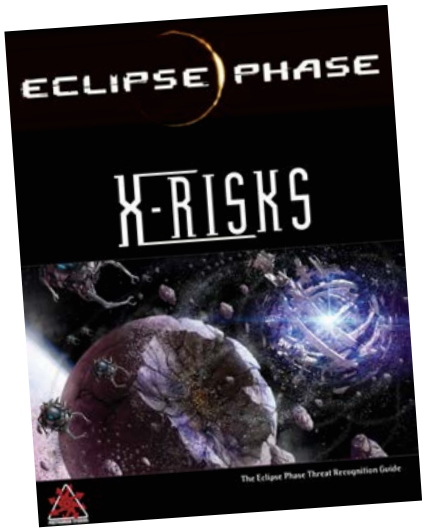

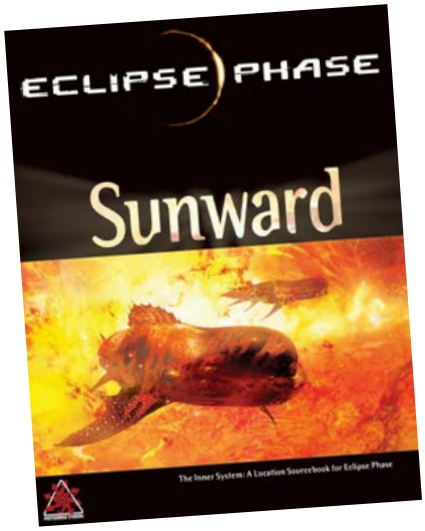

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PANOPTICON

Panopticon surveys three areas of the **Eclipse Phase** setting:

- Ubiquitous surveillance and sousveillance—living in a transparent society
- The inner workings of space habitats—and how to hack them
- Uplifts and smart animals—their scientific and cultural impacts
- plus new morphs, gear, habitat rules, and more!

ECLIPSE PHASE

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Jake Carter's hunt for his missing sentinel had taken him, by buggy and by mesh, in a wide arc around the Titan Quarantine Zone. Bobdog LaGrange had been missing for three days, and the trail Bobdog'd had his nose on wasn't one that led anyplace good. Finally, Carter got a break. A traffic spime on a ditchstop spur of the M-4 had gotten a facial match on Bobdog, looking drugged in the back of a car.

He'd traced the car to a saloon at the end of the spur road and called in a favor from Sage Kim, Captain of the Elysium Rangers, to ride shotgun while he checked it out. She wasn't Firewall, but Jake figured she wouldn't be seeing anything too crazy on what oughta be a simple rescue mission. Kim knew him as Jae Park, terraforming worker and sometime-smuggler, and he meant to keep it that way for now.

Kim's big gray Ranger flier circled the wide hollow at the end of the lonely highway once, then touched down near a dozen other vehicles, landing lights briefly illuminating the rusty Martian soil. The flier looked like the very mean lovechild of a large jeep and a fanjet VTOL plane. The front doors swung up, and Kim, Park, and a baboon hopped out, boots crunching on frost. Another baboon, masked against the thin atmosphere, pulled shut the doors and hopped to the front window of the flier, watching as the trio made their way across the landing lot.

"Cold enough to make dry ice tonight," Kim said.

"CO_2 doesn't freeze in the Labyrinth anymore, lady."

"Feels like it could tonight," she said, "Let's get inside."

Even in the relative shelter of Noctis Labyrinthus, the canyon walls didn't do much to stop the wind screaming across the Tharsis Plateau that night. They leaned in to the gusts, making a beeline from the prowler across the lot toward a lone building.

Both wore heavy boots, clothes made from drab fabric that looked like denim but acted like kevlar, well-worn sidearms, and rebreathers under dark balaklavas. Kim's kit loosely followed the regulation uniform of the Tharsis League Rangers (which was how most rangers followed uniform regs—loosely). Both were Asian phenotypes with ruddy skin—rusters.

The baboon followed in the woman's steps, stopping occasionally to scan the roof and windows of the building. Cape baboons weren't the prettiest creatures to begin with, but with goggles and a full breather covering the muzzle, the big male—she called it Smoke—looked damned scary.

The building was stacked together from twenty or thirty boxy green shipping containers. The place was only dimly lit in realspace, but in augmented reality a big neon sign flickered over the buidling's watchtower. It read, "Destino Verde."

"Thanks for helping me come after Bobdog," he said.

"If Bobdog didn't feed me tips nice and regular, I'd have put his ass away long ago," she said, "He's an idiot."

"Ain't gonna argue."

"And the less I know about what's actually going on here, Park, the better."

"Crystal." He clicked off the safety on his piece, heard the whine of magnetic rails going hot as she did the same. "Get your game face on, Captain."

"You've never seen it off." An AR graphic of a badge—the Ranger star with the Chinese characters for "justice" at its center—dissolved in over the lapel of her duster as she pulled open the building's outer door.

There was a gust of warm air. The place didn't have a proper airlock, just a couple of counterweighted pressure doors. Cheap to maintain, and good for us, Park thought. If they needed to make a fast exit, an airlock was the worst option.

He turned on his t-ray emitter, shared what he was seeing with Kim through their tacnet, and scanned the room on the other side of the door. Front of the place looked like a typical roadhouse crowd, with someone pouring drinks and about a dozen other people either propping up the bar or scattered around the room. There was more than one way to the back; a little way down one of the passages was someone on a stool—probably a doorman.

"Got all that, Captain?" he asked.

"Yeah," she said, "Go time." She pushed the inner door open and strode in, stopping next to the nearest table. The baboon hopped up next to her, pulled off its breather, grunted, and made a fist-smacking gesture that aped packing a box of cigarettes. She absently offered him a pack and a zippo while Park walked up to the bar. Style points for the lighter; self-igniting cigs were for spacers and dome dwellers.

"Hey there," he started in Mandarin, but the pleasure pod tending bar, whose outfit consisted of little more than AR graphics, cut him off.

The pod had a fresh face but a mean sneer. "Get that monkey outta here," she said to Kim, "This is a clean place." She was speaking English with an Indian accent. Sounded weird coming out of a morph that looked Japanese, but Park'd heard weirder.

Kim chuckled once. "This monkey's the Law. Get back to selling betel nuts, cupcake."

Park looked over his shoulder to see Smoke light its cigarette and take a satisfied drag, smiling to show huge canines. Whoever said smart baboons couldn't grok human insouciance was dead wrong, but Park also noticed the baboon had one hand on its shock baton.

SAGE KIM ■ MARTIAN RANGER

The pod stood there a minute, palms planted on the bar, attempting to stare down the ranger. Kim ignored the girl completely, slowly walking around the table, sizing up the other customers along the way, until she'd done a full circle, whereon she kicked out a chair and planted herself, one boot up on the table. [Only ones who might be trouble are the pair closest to the back,] she messaged.

Park didn't need to look their way; he was getting video from Kim in his tacs. He propped himself on his elbows and leaned on the bar like he was studying the beer taps, but his attention was on the little video window in the corner of his field of vision. Big blond guy and a stolid Japanese kid, both sipping their drinks slow and showing Yakuza nanotats. The blond guy was looking his way; his friend kept glancing at Kim.

JAKE CARTER AKA JAE PARK ■ FIREWALL PROXY

[Some heavy citizens,] he messaged. He glanced at the bartender, [And where you figure they got the cred for a model like her in a dump like this?]

Conversation in the room started up again, and the girl finally said sideways to Park, "What do you want?"

"Sorry about my friend. She ain't been feeling so great. Pint of Red Iron?"

The girl narrowed her eyes briefly at Kim, then looked back at him. "Your lover?" she asked. Jae felt a flutter in his chest when she locked eyes with him. Tailored pheromones?

"The captain? Nah, I just owe her a favor." Yeah, definitely pheromones; he was fighting not to get distracted. "She's due for some new genetic services packs; she's got achy joints and all. She's looking for a remedy 'til she can make the payments, wanted me along to make sure she didn't get put over the barrel on the price."

The girl finished pouring the beer and passed it over in a way that involved more bending and stretching than was strictly necessary. She said, "What's a terraform-wallah know about being over a barrel?" She'd made him quick, but then his whole look screamed terraformer, even with his network profile in privacy mode.

"You ever worked as a line engineer, you'd know the answer, darlin': plenty." He took a long pull off the beer; it tasted like burnt rice and the girl's perfume.

"Anyway, this is a bar … not a pharmacy."

He slid some cred into an AR payment window, tipping generously. "Ain't what I heard."

She glanced toward the pair of yakuza. Through Kim's video feed, he saw the young-looking one nod to her. "Why don't you and your friend try in back?" She pointed to a hallway to her left marked, "EMPLOYEES ONLY."

He abandoned the remaining beer. "Thanks, darlin'." He turned to Kim and nodded toward the hallway, and the two of them headed back. Smoke stayed perched on its table, eyeing the two yakuza.

The back room opened up into four cargo containers whose innermost sides, bottoms, and tops had been cut away, forming a big, mostly open space. At the back of it was a counter, and behind the counter was a tall stack of cases, drawers, cabinets, and hanging nets full of herbs, animal parts, and medicines in old-fashioned glass and plastic

containers. The old guy behind the counter looked Japanese, but the labels on all of the containers and most of the AR graphics floating over items for sale were in Mandarin.

"What you need? Whatever it is, I got just the thing," the old man said.

Park was suspicious as hell of anyone who chose to walk around in an old morph; meant you were either potent or desperate. "My lady friend's GSPs're up. She's got some joint pain. Normal meds ain't working. You got somethin' to restore her chi flow or whatever all this stuff is supposed to do?"

"Chi's serious business," the old man scowled. "I got a reed and marrow rub for that, just the thing."

Park said, "C'mon, oyabun. I know you got better."

"Ah, I have just the thing … Houzi cream." He started to take a tin from under the counter.

"Tinned? I could make that in a fabber. Quit trying to jerk me around, or we're going somewhere else."

The old man grunted, backed up and crossed his arms.

"You're worried about the badge, paatno-san? C'mon, we know this is a yak place. We're here for your merchandise, not to make a bust, or we'd have her monkey in here tearing your shit up already."

The old man scowled. "I can make you up a Houzi cream, but it ain't cheap."

Park messaged her, [Ask to see the gibbon.]

Kim crossed her arms and looked around the shop like she was thinking about it. [Are you fucking serious, Park? You think—]

[Just do it!]

She looked at the shopkeeper. "I'm gonna need to see the gibbon. That ain't a problem, right?"

The shopkeeper led them deeper into the maze of shipping containers.

[What's going on with this operation?] Kim messaged, [I seen some weird shit, but …]

Park messaged, [Traditional Chinese medicine. Old-timey, superstitious shit. It was mostly dead 'til the corps kicked in with the GSP racket and people couldn't find any cure'd work on their pains and asthma. Some of the recipes call for ape parts. They lop off the pieces to make the meds, then throw 'em in a healing vat, rinse, and repeat. People'll try anything, and they think uplifts make stronger medicine. Surprised you never ran into this before.]

[Wait, so what are the yakuza into it for?] she messaged. She was mapping out all the twists and turns they'd followed on the tacnet.

They passed through a barrier of hanging plastic, and the reek of confined animals hit them. The hallway opened up into the harvesting room. In the gloom, he saw a neo-bonobo drugged in a cage. Park peered at him, but it wasn't Bobdog—no dreadlocks. Unless he'd resleeved. Through another doorway, he could see a row of bear cages.

[Triads won't touch it,] he messaged, [They think it's a cultural embarrassment, if you can believe. But the demand's there, so the yakuza got into it.]

The yakuza rolled out a cage with a gibbon in it. Jake really wanted to find Bobdog and get out of here before he was responsible for them cutting on this monkey but … well, here was some fucked up shit he hadn't seen before.

The gibbon was hopping around in its cage freaking out, but it was also signing to him in Warlpiri. <Jake! Get me out of here!>

He signed from where the old man (hopefully) wouldn't spot him while Kim made a show of walking around the cage inspecting the ape. <Bobdog? That you?>

The gibbon tried to hoot, its throat sack inflating, but only a sick croak came out. <Yes! Get me the fuck out of here now!>

Park could see where they'd shaved him and popped his stack; they'd burned out his mesh inserts, too.

[That's a neo-gibbon. Bobdog's sleeved in it,] he messaged Kim.

She glanced at him over the cage. [How do you know?] she messaged, [It doesn't have a PAN.]

[Australian native sign language.]

She shot Park an incredulous look but didn't say anything. "Okay, it looks good," she told the yakuza.

The old man pulled out a metal pole with a wire snare on one end and started trying to catch Bobdog's hand with it, cursing under his breath as the neo-gibbon freaked out in the cage.

"I haven't got all day," Kim said, then messaged, [What's he doing?]

[If he gets a hold on Bobdog's hand, he's gonna slice it off with that vibroknife in his belt and use it to make your Houzi cream. Game time,] Park messaged, [How you wanna play this?]

She answered by breaking the old man's face with the butt of her pistol.

He fell back, screaming and clutching his broken nose. "What the fuck? You think that badge means you gonna walk out of here alive?"

There was a crash and screams from somewhere outside. On his tacnet feed, Jae saw the big blond yakuza looking terrified for a split second as Smoke turned over the table onto his companion and came at him with its shock baton.

Kim kicked the old man to the floor and pointed her gun at his head. "Open the cage now, and I might not shoot you."

The cage door swung open, and Park lifted Bobdog out and stood him on top of the cage. <Can you run?> He signed.

The neo-gibbon shook its head, signed, <Weak.>

Park lifted him. “All right, arms around my neck, pal. We’re Althauser 5000.”

<Not yet,> Bobdog signed, <You need to see what’s in back.>

There was a gunshot from somewhere down the hall. The old yakuza cackled sickeningly from the floor. “Stupid fucking garlic eaters,” he said, “When my boys get done with you, I’m gonna sleeve you up like that one and use you all for fucking monkey parts.”

Kim shot him three times, the railgun almost silent except for the crack of the slugs.

Park looked over in time to see the old man slump over. “Damn,” he said.

Park lifted the neo-gibbon just as the doorman from out front came tearing into the room. Park spun and leveled his pistol at the man. Bobdog was clinging to him like a baby; kid was gonna need some serious time in psych after this. “Hold it!” he shouted.

The guy hesitated for a second but kept coming, pistol out. Then the baboon took him down. Smoke leapt at him out of the gloom of the hallway, grabbing him around the neck and swinging its weight forward so that the gangster tumbled and fell to the ground. Smoke landed in front of the guy, then swung its baton hard into the wrist of his gun arm. Bone cracked wetly.

The yakuza grunted and sat up, holding his wrist. Smoke howled in his face, showing two huge canines. Smoke had been grazed by a shot, though its flak jacket had stopped most of the damage. The baboon looked pissed.

Park motioned with his gun. “C’mon, Toshi. Get in the cage.”

The guy stumbled to his feet, the baboon circling him. “Name ain’t Toshi.”

“Toshi, Fu, Iggins, whatever; get in the damned cage.”

He got in. Park put down Bobdog, pulled out his COT, and made a neat row of nanotack welds between the bars and the lock.

“Those’re illegal, terraform-wallah,” Kim said.

He looked up for a second. “So’s shootin’ technical old yak pharmacists for calling Koreans names.”

“I like monkeys and garlic. He messed with both in one breath. He needed killin’.” She looked none too penitent.

“Arright,” Park said, “This one ain’t following us. Now let’s see what all else they got hidden in here.” He picked up Bobdog again; the neo-gibbon pointed toward the bear cages.

She stayed put as he headed for the bears. “You’re kidding, right Park? We should go. Now. I’ll come back later with a tac squad and clean this place out.”

“They didn’t seem too afraid of cops. Whose jurisdiction is this, anyhow?”

“Gray area. My force doesn’t come down this way much. It’s on the line between me and the Noctis Rangers.”

“Who you know damn well got termites in the frame. Bobdog here’s down a cortical stack, mesh inserts, and a set of vocal cords over what they’re hiding in here.”

The neo-gibbon signed something in Warlpiri.

“What the fuck does that mean?” Kim asked.

“Uh, rough translation? ‘Cowgirl up.’” He shifted Bobdog to his back and headed into the bear cage room, gun first.

“Well, fuck. C’mon, Smoke.” She caught up, then took point, with the baboon bringing up the rear. [Gloria,] she messaged the other baboon, [Strap in,] and then to the AI in her prowler, [Dust off and circle high.] A few seconds later, the truck was a moving blip on their tacnet.

A few black bears looked up sadly as they crossed the room. They were stunted and weak, their wire cages barely allowing movement. A neatly attached catheter dangled from the belly of each—for milking their bile, if Park recalled rightly. Beyond that was a room with more primates—gibbons, monkeys, and another drugged out neo-hominid. The whole place smelt of sickly caged animals, and Smoke was getting edgy, sweeping the backs of his hands nervously over the floor whenever they paused. Kim gave him another cig to cool him down.

Kim came to a pressure door with a tiny window. Instead of peering through, she angled her gun so that she could look through its smartlink. Through his tacnet feed, Park could see the room beyond as she slowly panned. It was a lab set up: bunch of steel tables, equipment cabinets, industrial gear for filling up some small, heavily shielded cylinders—for gas or liquid, he wasn’t sure. There was a batch of a dozen cylinders racked up on the table.

All these details he took in after the back wall, though. In one corner was a heavily shielded incinerator—the kind that used magnetic containment and a blast of plasma to vaporize whatever was in it and then vaporize it some more. Next to that was a biocontainment chamber: a wide, white-lit, glass-fronted enclosure about five meters wide and three deep. There were three figures—or rather two figures,and a … thing—secured to the back wall of the enclosure with a multitude of heavy straps and room for two more.

One was Bobdog’s morph, a tall bonobo with dreadlocks. It was horribly emaciated but still breathing. Tumescent lumps studded its waist. The second figure was human, probably a ruster, but its skin had gone dead, nearly translucent white. Around its midsection writhed a double ring of stumpy tentacles surrounded by puckered scar tissue.

The third thing had only the vague outline of a humanoid shape. The legs had fused into a barrel

of muscle ending in a wet surface like the belly of a gastropod, and the head and arms had disappeared into the trunk of the body. The tentacles on this one were more active but similarly stumpy and scarred; looked like its keepers'd been trimming them back as they grew.

Kim sucked in a breath. "Damn it, Park, I don't know why I do favors for you. You get me into the weirdest shit. Is that radioactive?"

Park looked at the exsurgent. "No. And ain't your job patrolling a zombie graveyard for robot monsters?"

"That's got nothing on the kind of stuff happens every time I go on one of these runs with you. And this takes the cake. What the hell is this?"

"Stuff nobody oughta see." He edged up to the door and opened it, "Should be safe enough behind an enclosure like that, though." He went inside, and she followed, Smoke in tow.

"I hope you're right. What kind of operation you think this is? They're not cooking up tabs of hither in a setup like this."

Park said, "Trying to improve on bear bile, you want my guess. Mind watchin' the door, Captain?"

He put Bobdog down on a lab table. <Maintaining?> he signed.

Bobdog pointed at his morph, signed, <Fork of me. Infected. Kill it.>

<You got it,> he signed, but this was a bad scene. The Bobdog strapped to the wall was pretty far gone and infected with something; if he had a stack, better to destroy it. But he couldn't be too sure about the Bobdog he'd been carrying around the last few minutes, either. When he got out of here, their first stop would be a genehacker kettle in the tablelands about twenty klicks north. He had a friend who could give them a clean bill of health … or not. Park tried not to think about the "not."

He tapped at the window separating the room. "Hab window glass. Ideal." There was an airlock with a decontamination shower leading into the enclosure and a few clean suits on a rack. The set up was basic but looked like it'd work.

"Ideal for what?" Kim asked.

He walked once around the enclosure, estimating its strength. "Blast containment."

He started poking around, found a workstation with a rack of tiny quantum computers next to some of the lab equipment. [GiGi,] he asked his muse, [Can you get into this?]

[Mais oui,] the AI messaged, and started throwing exploits at it.

The baboon was having another cigarette. Thank goodness for bad habits, Park thought. There was another door leading farther back. If the schematic they built up on their flyover was any good, it lead to an exit.

Kim checked the back hall for herself, then asked, "I really need some answers about what's going on in here, Park."

Park started pulling on a clean suit. "You ain't seen enough illegal activity yet?"

"Human trafficking, animal cruelty, assaulting a ranger, possession of a biohazardous substance, possession of TITAN relics … Yeah, sure, I can throw the book at that old man if I pop his stack and take it in."

"Doubt it." Jake buckled on the boots and started checking the seals. "Bet you his stack's wiped. He's the type'll have a dead switch on a throwaway body like that. Or he wasn't that important."

"Then so it goes," Kim said, "But whatever's going on here, it's the low end of the food chain."

Jake sealed the helmet and ran the clean suit's diagnostics. [Probably true. I figure they're working on a way to infect more people. Can you do a visual inspection on the seals on this suit?]

[OK.] She went behind him, checking seals, then came around and gave him a thumbs up. [You think someone's trying to weaponize it?]

He dragged the storage cylinders into the airlock with him. Frost came away where his gloves touched them; they were self-refrigerating. [Maybe. Gotta look for the big fish now.]

Bobdog's clone tried to look up at him as he cycled the lock and entered the enclosure. He looked away; he couldn't meet the neo-primate's eyes. He suction cupped an incendiary charge to the window in front of Bobdog, then in front of the human. Finally, he set one up in front of the whipper, giving it a wide berth.

He squirted scrapper's gel on the storage cylinders. He stepped away as the gel burned through and blood began oozing from the cylinders. Three incendiaries would be plenty in a chamber this size.

When he glanced out, Kim was smoking, too. He'd thought the cigs were just for the monkey. [Shit, Park. We can't help him?]

He cycled the airlock. The chemicals from a decontamination shower hissed off the suit before the outer door opened. [You want to try? You know TQZ containment procedure.]

Park got out of the suit, letting the pieces drop to the floor, and found the atmosphere controls for the biocontainment enclosure. He adjusted the mix to hypersaturate the chamber with oxygen.

"What now?" Kim asked.

"I'll be done here in a few. We burn the stuff in there so it doesn't infect anybody else, and after that you can do whatever cop stuff you want to this bar." The exsurgent in the enclosure had grown restive in the

oxygen-rich chamber; it squirmed and whipped its stubby tentacles around. He sealed the oxygen line to the chamber; didn't want too big an explosion.

Kim said, "I still want more answers. They got infected by a TITAN virus, I take it?"

GiGi reported her intrusion complete. He spread out an AR window on the lab table next to Bobdog and showed her. "Thing farthest left we call a whipper," he said as he scanned the text, "Used to be a person; ain't anymore."

The chemical and biological data was mostly over his head, but what they were doing with it wasn't too hard to suss out. The yakuza were intentionally creating exsurgents, milking them for bile and other fluids, then shipping the goop somewhere for processing.

"Who's 'we,' Park?"

"Huh?" He stopped reading.

"You said, 'What we call it.' Who's 'we?' Are you a fucking Oversight spook or something?"

Park laughed, "Nah. I work for the good guys. Least, that's what I think most days. I was kinda hoping you'd sign up."

GiGi messaged, [J'ai toutes les données,] into the AR window.

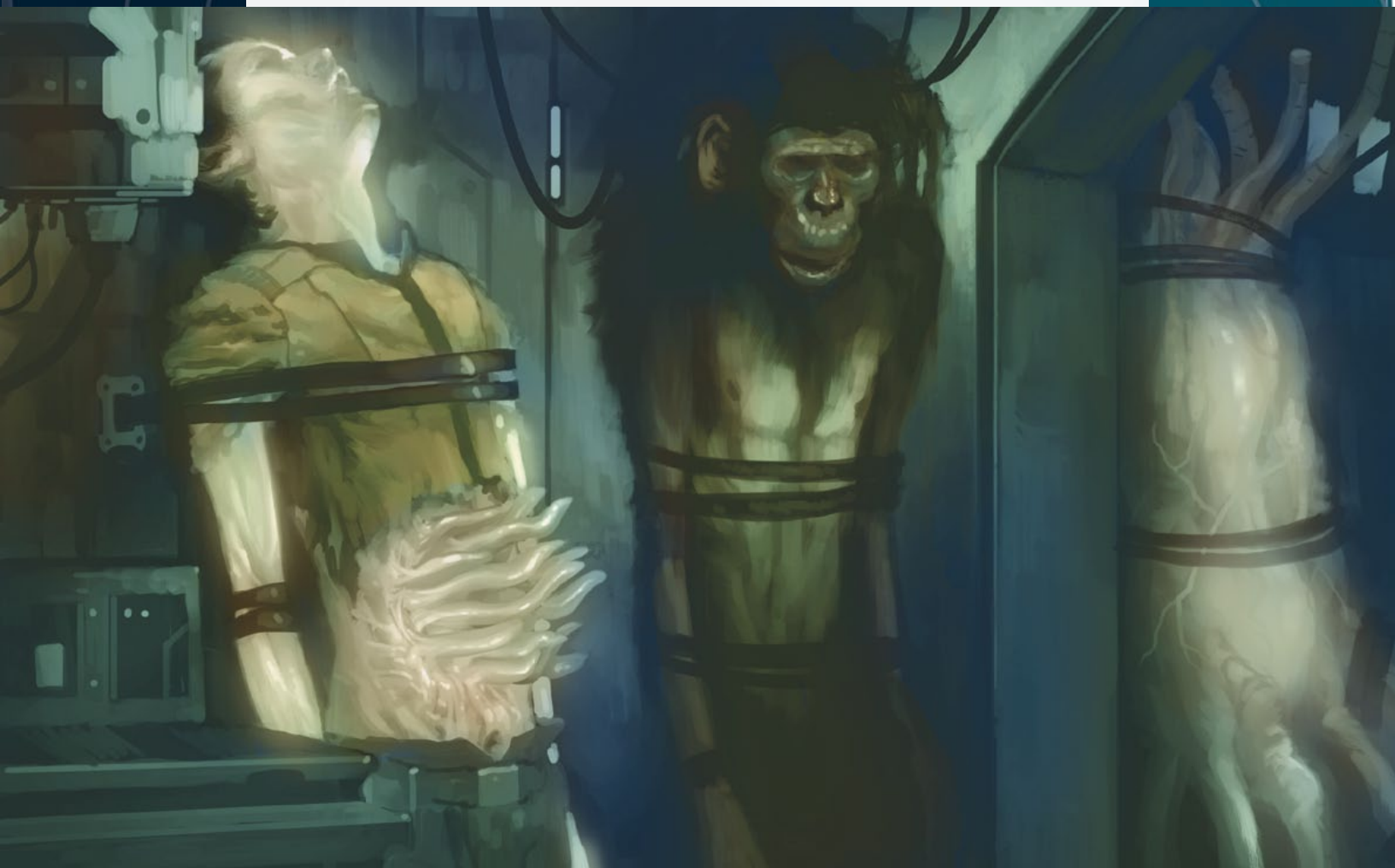
She raised an eyebrow. "Your muse speaks … is that French?"

He grinned, closed the AR window, picked up Bobdog, and made for the door. "What? It's sexy. She's got all the data. C'mon, I can explain the rest when we're safe in the air."

They put a breathing mask on Bobdog, wrapped him in a heavy blanket, and walked right out the front door. The yak in the cage cursed at them as they passed, but they let him be. The pleasure pod bartender and bar patrons had fled the front of the bar, so they weren't around to hear the muffled explosion from far back in the maze of shipping containers. The camera Park had left in the room showed that the containment unit held; inside was nothing but ash.

Kim's prowler touched down, Gloria peering at them out the front windows. Park wasn't sure whether a yakuza cleanup crew or Kim's ranger buddies would get there first, but in the scheme of things, that wasn't so important. They were in the air, and headed for the hills.

Part 1 of 3; To Be Continued…



2 SURVEILLANCE

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Source: *When the Emperor Wore Clothes,* by John Perry Schneier [Link]

Lifeloggers capture every instant of their existence for their own reference. XP stars live, love, and die with passionate abandon so everyone can enjoy it on demand. Habitats depend on constantly updated operational and environmental data as well as troops of transhuman observers to function seamlessly and provide the day-to-day necessities of transhuman life. Hypercorps, governments, organizations, and individuals safeguard the information they need to survive and seek out what they need to thrive. People can access the locations and live streams of their children, friends, loved ones, or complete strangers at whim. Muses regularly access the social profiles and public records of everyone their patrons interact with, transforming total strangers into familiar faces, before greetings are even exchanged. Knowing what's going on across multiple fronts simultaneously is absolutely vital to survival after the Fall, and the only way to do that is to employ a panoply of technologies and behaviors designed to keep track of everything. Technology has enabled universal perfect recall for everyone and for most of the devices they use on a daily basis.

Who watches the watchmen?

Everybody. Always.

OUR TRANSPARENT SOCIETY

"I'll admit I'm underhanded. The reason that none of you could find vid of my birth is that there isn't any. This task was meant to show you the limits of data mining when you don't have a complete personal history. The three of you who submitted links to your own fake films will receive extra credit. Jeung, however, you're losing points because you got my natal phenotype wrong despite that being public record."

—Rokuzawa Chi, Prof. of Individuality Studies, Titan Autonomous University

"Shit, she's old."

—Abwe al Sul, Junior in Memetics

As social animals, humanity's voyeuristic tendencies seem ingrained. We monitor our neighbors and peers, staying on top of trends and keeping up with whatever is hip and fashionable. We seek out news, because what impacts others may impact us personally. And we love to keep tabs on the glamorous and powerful, hoping to get a glimpse of their exotic lives or whiffs of their secret plans. Similarly, those with something to protect, whether it be wealth, secrets, power, or loved ones, keep a wary eye on those that may pose a threat. Information is gathered to keep ahead of rivals, to market products more efficiently, and to control the masses more thoroughly.

Counter to these spying instincts is our innate desire for privacy, to keep our personal affairs to ourselves, to have the freedom of anonymity and secrecy when we desire or need it. The intersection of privacy and security has become a contested area in recent centuries, a confusing exchange due to competing and sometimes overlapping interests. The inexorable advance of surveillance technologies and digital networks seemed at first destined to undermine fundamental concepts of privacy and personal freedom, sparking fears of Orwellian police states and information dictatorships—until the democratization of such tools turned the tables. Now, after the shockwaves of such disruptive technologies have passed, transhumanity has largely adapted to an open society, albeit to varying degrees. To understand this current state, we must evaluate the path that brought us here.

THE ASSAULT ON PRIVACY

The rise of pervasive surveillance occurred contemporaneously with the technological and societal changes of the 20th and 21st centuries. Well before the Fall humans were developing ever more pervasive means of documenting their lives and actions. The growth of computer networks in the late 20th century created new opportunities for collecting, archiving, sharing, and cross-indexing data. Old analog records were digitized, increasing their accessibility, making it easier for governments and corporations to share information and track people. New databases sprung up by the billions, sparked by the ease of collecting and manipulating data online. Early users of the internet were largely ignorant of the trail their activities left online, and the many ways in which companies discreetly gathered information on their habits, interests, and personal details, creating detailed profiles of individual users. While many of these archives were bought and sold in private for marketing and commercial purposes, others were left open for the public, making it easy for millions of amateur sleuths to gather information on others. People increasingly found it difficult to escape their pasts, whether it be marred by bad credit, poor driving records, or criminal violations. Even records that were presumably private and restricted, such as medical histories or financial records, suffered from poor security, becoming the victim of public breaches. Criminal networks arose that were dedicated entirely

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to trading and selling credit account access or compromised accounts to private archives.

The spread of centralized communications networks also enabled new capabilities for surveillance. Whereas harsher regimes shirked no opportunity for monitoring communications in order to root out dissidents and other challenges to their authority, more democratic regimes were marked by widespread civil liberties that restrained government snooping. Nevertheless, as communications channels became increasingly networked, even these more liberal states found excuses to engage in widespread spying. Financial transactions to other countries were subjected to heavy monitoring to deter money laundering, tax evasion, and similar financial trickery. Spy agencies enacted vast data mining efforts to sift through immense amounts of voice and data communications and "listen" for keywords, forwarding any interceptions that raised flags for closer analysis. Wars against drugs, terrorism, and other causes were used to legitimize initiatives for systematic surveillance and further erode privacy safeguards. Security was increasingly the buzzword argument applied to justify border checks, tap communications, access private records, and institute mandatory identification cards and similar measures. Many governments grew so voracious for information that intelligence gathering became SOP for everything from civic programs to embassy relations.

Resistance to Big Brother

Privacy advocates were not without support or resources and were largely rooted in hacker and cypherpunk subcultures. In addition to lobbying for privacy rights and creating awareness of creeping surveillance conditions, they established the first digital tools for anonymization and encryption, enabling people to interact online without fear of tracking. These tools were embraced by dissidents, whistleblowers, criminals, people living under oppressive regimes, and anyone else desiring to keep their activities secret. Their adoption was limited, however, as their use (or even awareness of their existence) often depended upon a non-amateur level of technical proficiency. They were also engaged in a constant arms race against new surveillance measures and repressive governments and businesses who would shut their distribution sites down or criminalize them.

Like This

A major turning point in the war on privacy was the widespread embrace of online social networks. With the increasing capability to share the minutiae of their lives instantly via the web, humanity stumbled into a participatory panopticon. Status updates, microblog postings, photo and video feeds, and other publicly accessible media streams created a self-maintained, searchable, and public record of most people's lives. Many people integrated themselves into the public domain without any thought to the implications of their participation. By opting in, it was easier to keep up with more friends in greater detail, maximize social and professional exposure with less time, and partake in slices of thought, public discourse, and new participatory media. Opting out reduced an individual's sphere of influence and notoriety and risked branding oneself as a technophobe.

The companies that sponsored these social networks were financially motivated to increase the amount of data people shared online, so early models were designed with minimal privacy options or with such features turned off by default. Participants were increasingly steered towards making their profile, data, and activities public. As a result, those who wished to participate but maintain some privacy were forced to develop information management skills, as they attempted to control how their data was shared and with whom. New generations grew up in this networked world, never aware of life before social networking, thus embracing a drastically different and more nuanced concept of personal privacy than previous generations.

Considerations of who really owned the data posted on these networks and rules governing its fair use and reproduction rights were ignored by the majority. Even when serious concerns managed to rise to the level of public awareness, the benefits of continued participation usually outweighed the psycho-sociological value of personal privacy. By the mid-21st century, most of the world was well aware that they were active participants in a global information system that recorded most of their lives. Privacy was something controlled with check boxes in profile settings, and data was meant to be shared.

Reputation Growth

The formal reputation networks that exist AF arose organically from the informal social media developed through the 21st century. An early barrier to interacting with strangers online—particularly when engaging in financial transactions—was not knowing if the person you were dealing with was reliable. Primitive reputation scores were the first solution, enabling buyers to rate sellers. These systems rapidly spread to social networks, discussion forums, and filesharing sites, as a way of valuating participants. Concurrently, for the first time, individuals had access to the same public presence capabilities and image-making techniques formerly reserved for those retaining expensive PR firms. Individuals with huge friends lists and blog followings had commercial pull that could sell products, fill clubs, top up campaign coffers, propagate memes, and make or kill trends.

Likewise, companies and social organizations seized an opportunity to more carefully control their public image for increasingly savvy consumers, in an attempt to manage the ratings their products and services received online. Corporations created

network presences for their mascots, pitchmen, and products that gave them almost the same data footprint as flesh and blood people (some of the earliest AIs and infomorphs were cultural idoru or designed to maintain online interactions for commercial entities). Although BF networks didn't have the direct, tangible economic impact of their AF successors, they were a vital stage in their development because they created the linkage between individuals opting in to public information networks and socio-economic benefit. Reputation was increasingly tied to participation in public data sharing, and a polished presentation across multiple media formats and networks was a key to success for individuals and organizations alike.

Technological Tool Growth

The information networks that developed were supported by rapid technological changes. The comparatively crude recording devices of the mid-20th century were replaced with compact, sophisticated smartphones, tablets, and primitive ectos that eventually rivaled the computing power and speed previously only found in desktop computers. Miniaturization coupled with a shift to cloud computing—the storage of data with online services rather than on an item's own on-board memory—allowed for people to not only generate their own content on-the-go but also to access all of their data anywhere almost instantly. Mobile accessibility became akin to being important, and in the generation before the Fall the average 12-year old had more mesh presence and searchable media records than most 20th-century world leaders.

The mobile communication networks also helped to bridge the gap between physical and digital tracking. Mobile devices betrayed the user's ongoing whereabouts to the network providers and government snoops, a monitoring function that was played up as a feature for social networking purposes.

Simultaneously, the availability of cheap cameras and sensors allowed authorities to cast an ever wider physical surveillance net. Urban centers became inundated with small cameras in shops, schools, and offices as well as on street corners and traffic fixtures. Police agencies tied many of these cameras together into an efficient city surveillance network. Initially implemented to deter crime and police traffic, their real value was for investigative and blanket surveillance purposes. It soon became possible to track people's movements efficiently from watch zone to watch zone. Many of these cameras were also accessible publicly online. Private security services, with too many cameras to watch, pioneered the idea of crowdsourcing surveillance footage, offering rewards to those who reported incidents promptly.

Public and private camera networks were just the first step. These were soon followed by traffic radar systems, car-mounted cameras, audio and acoustic microphones, balloon-mounted aerial observers, and numerous other sensors. Millimeter-wave full body scans and chem sniffers awaited travelers at security checkpoints, radiation sensors guarded major ports and travel routes, and helicopter-mounted thermal scans facilitated drug busts. Radio frequency tags in consumer products automated purchasing—and enabled easy tracking of spending habits and physical inventory. The same tags in IDs streamlined security checkpoints and credit account access—and further aided monitoring efforts.

Surveillance capabilities were further magnified by the addition of biometric scans, pattern-matching algorithms, and other software analysis tools. Fingerprinting and DNA-sampling grew from forensics tools to mandatory requirements for checkpoints and entire populations. Facial and voice recognition helped to identify people quickly, whereas gait analysis and similar programs were effective in identifying people who were disguised. Finding individuals in large crowds or even large cities became easy. These tools made it increasingly difficult to move in public without leaving a trail, creating new challenges for criminals, revolutionaries, and those who still fought for privacy.

The Democratization of Surveillance

As the tools of surveillance became cheaper, smaller, and more accessible, the public put them to use for their own purposes. Abuses of power by the police and other authorities were increasingly caught on camera and put online, quickly going viral and bringing injustices to light—sometimes even sparking long-simmering rebellions. Combined with the ease of sharing these videos with a mass audience across the world, and thugs and dictators increasingly found that they were being watched back. Thus began the first real era of *sousveillance*—watching from below.

Sousveillance first made a real impact on the world stage when organizations arose that were dedicated to revealing government and corporate secrets supplied by anonymous informants and whistleblowers. The information leaks these groups published often embarrassed major governments, forcing them to run damage control measures, and brought the realities of political hypocrisies into the spotlight. The entrenched elites reacted as expected—by attempting to restrict the information. Laws were passed that criminalized recording police or public figures. Leaks groups and whistleblowers were hounded, smeared, cut off from funding, and prosecuted. Crackdowns were launched to censor and silence the voices of dissent. Disinformation was spread to muddy the waters. Massive firewalls and information filters were put into place, limiting public access to blacklisted sites.

Ultimately, however, they fought a losing battle. Anonymous leakers avoided persecution. Hacktivists found ways to spread information past the strictest blockades. Networks treated censorship as damage and routed around it.

THE NEW JOURNALISM

The arrival of anonymous leaks groups brought to light the sad state of mainstream journalism, already struggling to adapt and compete with new media technologies. Old school print reporting was in major decline, meaning it no longer had the resources for thorough investigative journalism, while video news had been co-opted into a new form of entertainment. This meant that much of what passed for news was largely regurgitated from government and corporate press releases, when it wasn't a state-owned media outlet or corporate subsidiary already. Even the media of representative democracies had grown cozy with the establishment, accepting restrictions and trading away true reporting for the opportunity to be embedded within military units and the halls of power. In comparison to the sharp and daring leak outfits, traditional media was toothless.

Alongside these spillers of secrets, a new generation of independent media outfits, crowdsourced media, and citizen journalists were rising to the fore, also empowered by networks and sousveillance technologies. As their reputations grew, these new journalists challenged the orthodoxy of the old media, often beating it at its own game. In a bid to stay relevant, news agencies were forced to hire new journalistas as freelancers, keep them on as retainers, or else outbid their competitors for the rights to breaking news items.

Thus we have transitioned to the hypercorp model of journalism we see today. Media feeds pull the hottest items from the swarm of freelance journo contractors (both amateur and pro) with whom they are meshed, paying standard rates in instantaneous transactions mediated by AI, bringing you the best news available in real time. In the outer system, media collectives act as content aggregators from similar full-time and ad hoc sources, with reputation playing a key role in keeping the attention of others. This effectively transforms almost everyone into an ad hoc reporter should they have the right connections or simply be in the best position at the right time. The eyes and ears of media feeds surround us on a daily basis. ■

THE PUBLIC EYE

As the facade of government and corporate secretiveness was inevitably pulled away, layer by painful layer, even the detractors of information leaks were forced to admit that the evidence brought forth by whistleblowers brought greater accountability to the public and private sector. Slowly but surely, calls for greater transparency and openness were adopted as the new paradigm. Many jurisdictions instituted whistleblower protection laws, some even going so far as to encourage and reward snitching when done through appropriate legal channels. As individuals became more enmeshed in public information networks and more and more personal and historical data was put into the public domain, there was a growing demand for equivalent access to the inner workings of government and private industry so the public could make informed decisions about who to vote for, what to buy, and how to invest. Arguing that governments and businesses had access to vast amounts of personal data used for advertising, demography, taxation, and legal action, the populist outcry for transparency held mass appeal and proved impossible to ignore in many countries.

Additional pressure for greater disclosure came from social networks—reputation hits and negative feedback could and did have serious political and economic consequences, though less extensive and less instantaneous than those AF. Being branded as secretive or dishonest was a hard label for politicians and corporations to shake, and the lack of full integration between new media/social networks and factual news outlets made it particularly difficult to fight those claims.

The response many organizations adopted then (and continue to pursue AF) is to provide overwhelming amounts of data to the public. This provided a two-fold defense. First, it allowed immediate deniability to any charge of withholding data. Second, the sheer volume of data available meant that almost any argument could be made or refuted with selective referencing and correlation to other publicly available information. This is a rapid, cheap response that puts the onus back on the accuser to make detailed and documented claims of specific wrongdoing, thus aiding efforts to discredit detractors. Given the hyperabundance of information, few had the time or desire to sort through it all to get a complete understanding of what was going on. The switch to the disclosure model created a new service opportunity for datagogues, interpreters, and self-described experts to sort through all of the information and provide ready-made arguments in support of whomever paid them. With selective correlation, virtually any position could be defended. Analysts with decent reputations often garnered more followers and interest than the actual data released.

The transition to more transparent political and corporate operations did not occur overnight—it was a slow process, with much resistance. The figures who fully embraced it early on, however, were notable. When Varun Chakrabarty, the governor of Shackle, responded to a scandal over alleged favoritism in construction

NON-DISCLOSURE vs. HENCHMEN LAWS

In an effort to stem the flow of insider information their businesses were hemorrhaging due to new transparencies and digital vulnerabilities, many corporations initiated heavier non-disclosure restrictions on their employees and partners. Backed by stiff laws, a disclosure violation could incur serious penalties, including liens on the perpetrator's credit accounts. These non-disclosure agreements also were applied against business partners who were the source of involuntary leaks or data thefts, encouraging all parties involved to heighten their security against intrusion. In some cases, corporations were even able to win settlements against people who had revealed information but were not bound by non-disclosure by invoking the corporation's own need for privacy to stay competitive.

Counteracting these developments were so-called "henchmen protection" laws and prizes enacted in certain jurisdictions. These laws not only gave protection to insiders who blew the whistle on illegal or unethical corporate activity, they actively encouraged such leaks by offering rewards and other incentives. These prizes were often significant enough to tempt even the most loyal co-conspirators, prompting those engaged in corporate malfeasance to pursue more significant means of leverage against those trusted with explosive secrets. ■

contracts in BF 18 by broadcasting his lifelog to the public in real-time, many politicians and later some corporate officers followed suit in order to avoid any potential accusations of improper conduct. Though this did open them to criticism over minor details and interactions, the early adopters found that they were able to establish greater trust with their constituents, which usually translated into higher approval ratings and stronger popular mandates for their policies. As the public surveillance systems became more robust and concerns over potential abuse of information arose, Chakrabarty and others like him were able to point to comprehensive surveillance as a guarantor of public accountability and thereby quiet opposition. Though many regimes and figureheads stuck to the veil of secrecy and attempts to control information, some jurisdictions went so far as to make full transparency for public servants a legal requirement.

THE AI REVOLUTION

The development of weak AI had a significant impact on sur- and sousveillance capabilities. A new breed of fast, programmable, pattern-spotting, copyable watchers was implemented onto spynets everywhere. No longer was it necessary to crowdsource human eyes to watch every camera—software agents picked up the slack, replacing physical eyes with virtual ones. The weak point in many security systems was often designated as human error and behavior. These vulnerabilities of old were patched—and then replaced with an entirely new set of potential failure points. AIs may have successfully replaced the need for human observers and served as a surveillance force multiplier, but they had their own faults. Early AI intelligence was often not up to the task of analyzing sensory input as capably as humans could, though this improved over time. More importantly, AIs introduced new varieties of software vulnerabilities. Entire surveillance nets could now be compromised by skilled hackers, with one spoofing technique working against thousands of AIs. It quickly became apparent that for important spynets and high-security operations, human oversight was still a requirement.

Later, when uploaded human minds—infomorphs—came into play and more advanced AGIs developed, the situation once again changed. Now, the maxim is that observation systems that rely solely on automated software and simple AIs remain vulnerable and not completely trustworthy. The most reliable systems employ AGI and/or infomorph oversight.

The advent of AIs also brought personal muse assistants into play. With these helpers, individuals could now monitor sensor feeds without effort, tasking their muses to alert them to anything that matched their noted preferences. This simplified environmental awareness and brought personal information management to a whole new level.

THE CHANGING FACE OF TRANSHUMANITY

The arrival of resleeving technology created massive new challenges for the surveillance and identity infrastructure. No longer could people be identified solely by their faces, their biometric prints, or by any other aspect of their physical body. An entirely new system of identification had to be enacted, based on an individual's brainprint, in order to track who a person was as they switched from morph to morph.

The capability for forking created even more headaches and loopholes. Legal systems scrambled to keep up with the repercussions, not the least of which were thorny questions regarding the legal status of forks and any rights they might have. This was further complicated by the first cases of forks seeking legal emancipation from their owners, the first cases of assault and murder against forks, and several inheritance cases.

MIND SURVEILLANCE

Advances in cognitive science opened new vistas in the realm of so-called mind-reading for surveillance. Prior to the breakthroughs with uploading and resleeving, science had developed several methods of brain-scanning (usually using functional magnetic resonance imaging) to detect when people were lying, cheating, or making false promises. Though the accuracy of these readings was still debated in scientific circles, many police agencies had no compunction against using them in court. Similar tests could be used to confirm a person's recognition and memory of certain items, faces, or places, potentially linking them to criminal events.

Real progress, however, came with developments in uploading and psychosurgery, enabling invasive access to a mind's deep recesses. Such interrogations brought hostile outcry at first—even among transhumans, the mind remains a sacrosanct place, off-limits to others. The first uses of psychosurgery for questioning were condemned by human rights groups. Legally, they were challenged as a violation of an individual's right against self-incrimination. The utility of this interrogation method was not lost among those in power, however, and its use rapidly spread among the world's intelligence and security agencies. Forknapping also became popular with criminal groups due to the secrets that could be extracted from a victim's mind and the potential resale value to soul-trading outfits.

Along with invasive psychosurgery, a similar fear rose as the first cyberbrains were brought into use. For the first time, transhuman egos were subject to actual brain hacking. Even scarier was the fact that cyberbrain hacking could be conducted remotely—and quite possibly without the victim's awareness. Despite high premiums placed on cyberbrain security, mind hacking remains a serious potential vulnerability among synthmorphs and pods. In fact, some people refuse to resleeve in such morphs for fear that their egos would not be safe. ■

While both resleeving and forking were heavily restricted on Earth before the Fall, these technologies were embraced among the off-world hypercorps and autonomists. Legal standards and customs barely had time to grow accustomed to these new capabilities when the Fall came and threw everything off kilter.

DATACLYSM

The wars leading up to the Fall were turbulent times for the global panopticon. Transparency suffered as security measures were ratcheted up. Information control became a major issue as memetic warfare raged across the ideological landscape. Even before the TITANs appeared, netwar attacks subverted and disabled information and communication networks. Everything from personal devices to multinational satellite webs were plagued by technological (and sometimes physical) assaults. Bandwidth was regularly hijacked, overrun with junk data, or crippled by denial-of-service attacks. Botnets and worms waged silent struggles for mastery. For months, the surveillance nets were unreliable at best, blinded at worst. Databases and archives also suffered, from personal lifelogs to government records. Then the TITANs arrived and the real damage began. As transhumanity abandoned its homeworld, it also left behind untold troves of data.

The effects of the dataclysm wrought by the Fall were far-reaching. Aside from the immediate strategic and tactical impact of losing access to so much data and so many information networks, there was a long-term cultural and psychological effect on the survivors, particularly those who escaped Earth with only their egos. Millions had lost access to their personal records, their lifelogs, and their electronic memories.

The remaining governments and dominant sociopolitical memes faced a crisis of relevancy when stripped of access to their bodies of law and institutional memories. Individuals fleeing Earth lost access to many of the structures underlying their core identity, whether due to lack of complete personal records, material loss, or the destruction of their families, companies, and geopolitical organizations. Entire cultures lost access to their histories, their artifacts, and the knowledge of their pasts and traditions. The body of transhuman knowledge was dealt a grievous blow as much of its contemporaneous and historical information was archived in the long-standing data storage infrastructure on Earth and wasn't replicated elsewhere. In the chaos of the Fall, there had been no systematic effort to backup transhumanity's complete data library—only selective bits and pieces survived.

One serious by-product of the Fall was the backlash against AIs. AIs of all stripes and levels of complexity were subject to dramatic curtailments in their runtime and allocated processing power while new safeguards and monitors were put in place. Though some were shut down or deleted, many were integral to the operation of the security and life safety systems of habitats and couldn't be entirely deactivated. The ongoing dependence of many security systems on biological or at least non-AI staff to operate the most sensitive functions is a continuous reminder of lingering mistrust.

Many of the legal precedents denying AIs independence and personal sovereignty were enacted as matters of immediate necessity during and immediately after the Fall. To this day, many habitats, particularly on Luna and Mars, impose artificial limitations on AI/infomorph processing power and runtime. Many jurisdictions also retain limits or prohibitions on activating infugee egos from cold storage, due to ongoing security concerns over the mental stability of these egos and potential infection vectors—a fact that draws perennial protest from infomorph/infugee rights activists.

TRANSITION

Immediately after the Fall, transhumanity was clinging to existence by the narrowest of margins. Various polities and groups depended on every information-gathering tool at their disposal to identify and respond to the threats posed by TITAN activities as well as execute a rapid and massive social re-organization, particularly handling the unplanned influx of refugees to habitats across the solar system. Rationing, redirecting industrial output, and habitat planning and building were vital, particularly on Luna and Mars, where infugee concentrations were largest. The tattered remains of governments and the suddenly prominent habitat leadership were faced with hundreds of life-or-death decisions that depended on nuanced responses to complex skeins of interaction—and no one had a clue what was actually happening.

THE OPEN SOCIETY X-RISK

Many detractors of a transparent society are quick to point out that the TITANs were the epitome of transhumanity's surveillance dreams. The TITAN systems were originally designed as netwar systems built on top of massive, distributed spynets. Total Information Tactical Awareness Networks—the name says it all. When they awakened and began boot-strapping themselves towards super-intelligence, they used their access to worldwide surveillance, data mining, and information networks to learn all about transhumanity and spy on us from within our own computer systems. Now we rebuild those spynet systems—more efficient and prevalent than ever—within our habitats, populating them with AI, AGI, and infomorph helpers. ■

LEAVING THE PAST BEHIND

Many people took advantage of the chaos and loss of records during the Fall to leave their old selves and forge ahead with fresh new identities. Some of these were people who simply wished to forget their past, to sever the connections to their former lives and lost loved ones, but many were criminals and subversives looking to shed their checkered pasts. Some were even war criminals, responsible for looting the treasuries of national governments, massacring civilians, or condemning thousands to succumb to the alloy claws of the TITANs. Not all adopted new identities—for many it was easy to take over the personas of those they knew to have fallen during the exodus.

To this day there is a thriving business for ego hunters in tracking down people who cast off their old identities in the Fall. They pursue lost data and cold trails, hoping to find war criminals to drag before tribunals, claim rewards on stolen riches, or reunite lost ones with estranged family or lovers. ■

Thorough and accurate demographic data was crucial to many of these recovery efforts, so new systems were developed to account for transhumanity's surviving population. Often the burden of providing this data was shifted to individuals. If a person wanted food, shelter, and air to breathe, it was their responsibility to quickly and accurately provide census and data to the local auditor or authorities. Efforts to make and defend claims on personal property gave rise to obsessive self-documentation. Almost all fabbers and makers were being used to produce food and daily necessities, so usage records became an important part of public domain data when politicos argued their own impartiality and the necessity of the data-gathering operations.

Overt and covert surveillance systems were expanded to keep watch for ongoing TITAN activity and to assist in the management of the newly displaced population. Due to the tensions caused by the evacuation, cramped living conditions, and limited resources, those in power used every tool at their disposal to observe and quell criminal activity and unrest among those thrust into their care. In response, the general population brought back as much sousveillance as possible to keep an eye on the authorities; many survivors were living in habitats where they had no official standing or relationship to the local power structure, so they relied on their own video and data-gathering to protect themselves from abuses and neglect or to whip up public outcry in their favor.

The re-establishment and expansion of pre-Fall social networks was important psychologically as survivors tried to reconnect with friends and loved ones. The reputation economy rapidly matured from people passing along information and aid to a sophisticated exchange of social obligation; for many, the only thing they could trade on was the strength of their name. Social networks also were a vital instrument to the rebuilding of social ties and connections, establishing new cultural groupings and memetic tribes to replace the shattered identities of Earth.

The major delineation between the new surveillance/sousveillance networks from their earlier 20th- and 21st-century predecessors was that these were discussed and planned as such in public discourse. The previous de facto universal surveillance was deliberately recreated with an updated architecture that emphasized the active participation of the individual for the express purpose of creating, sharing, and protecting a thorough public record of personal actions. In essence, a new participatory panopticon was embraced as beneficial to the public and authorities at large. This was particularly true in autonomist holds, where an informed and collectively networked populace acted in place of authority figures and police. The exigencies of the post-Fall era made sure that opting-in to the universal data exchange had direct social and material benefits. The all-seeing eye of central authority had been replaced with the ever-present eyes of the general public.

Given the variety of political structures and social arrangements throughout the solar system, the adoption of the new transparent societal model is not universal. Many jurisdictions still emphasize authoritarian monitoring and discourage or even counteract public sousveillance. Others embrace it fully, going so far as to legally mandate it. Most telling, perhaps, are the varying attitudes towards personal privacy, and whether it is regarded as a privilege or a right—or in particular a right essential to personal liberty. In some habitats, operating in private mesh mode is considered rude or even illegal. In others, it is accepted and encouraged. These attitudes extend even further, ranging from being subject to totalitarian searches with no legal recourse to accepting the use of personal privacy shrouds.

One universally accepted argument for the participatory panopticon is a need for keener vigilance against a repeat of the disasters of the Fall. Systems of pervasive data-logging and comprehensive surand sousveillance are considered fundamental to protecting transhumanity from future disasters.

SURVEILLANCE SOCIETY 2.0

Now, a decade after the Fall, it is common for individuals to have a massive presence on multiple networks simultaneously. Each person creates a

constant data trail of location and activity through their mesh presence, social profiles, online activity, and personal gear. If those connections are monitored, it's possible to find out what they're accessing, with whom they're interacting, and where they are located. This activity can also be traced into the past via various records, as well as extrapolated in the future with a fair amount of certainty using predictive algorithms and historical records. Spimes, publicams, and private sensors record an individual's activity in most public areas. AIs and pattern-matching algorithms scan their biometrics on a regular basis. Businesses and other individuals will retain peripheral records of economic transactions through social networks or credit transfers. Other people around them are also lifelogging and looking through walls, clothes, and public records with sensory and software suites. The indirect data of individual actions accrues in everyone and everything in their vicinity. Then there's the publicly available information each individual generates with status updates and media sharing. That information is also supplemented by "private" recordings, archived in enhanced memory or external storage hosts. Even the soft, wet recording in the brain is stored in the cortical stacks almost every transhuman has and is backed up regularly.

Pervasive surveillance is a social norm. Most transhumans appreciate that they are being watched and recorded every moment of their lives. For some, it's a reminder that they're always on, constantly building social networks, fame, or infamy. Others take comfort in observation, knowing that they are being watched but that the same systems also look out for their personal safety and the calm, safe, dependable operation of their homes. Everyone benefits from the changes in law enforcement and public safety: crime is down, perpetrators are almost always caught and victims are compensated.

Privacy, however, is not dead. Homes and personal areas feature privacy filters that allow access only to authorized individuals. Privacy modes can be erected to withhold information and deter tracking. Anonymization services, encrypted communications, and crypto-cred enable people to hide their activities from watchful eyes. Disguises, privacy shrouds, and pseudonymous morphs allow for individuals to go about their physical business without recognition. Other tricks of the trade remain for spies, criminals, and revolutionaries.

Identity and Identification

One of the biggest challenges facing transhumanity is how individuality is verified and protected. Despite the wealth of data accumulated on (or made available by) people online, the nature of resleeving makes identification a difficult task, compounded by the lack of a centralized system-wide verification system. Forking and the occasional death add a range of legal considerations and headaches to the mix. On top of this, some factions eschew identity verification and/or allow people to act with anonymity or under multiple pseudonyms. Criminal groups keep everything spicy by engaging in identity theft and forknapping.

ID Systems

Most polities that embrace ID systems rely on nanotattoos and brainscans for physical identification. For infomorphs and AGIs, the cryptographically signed digital code embedded in the software of each brain-state serves as their unique identifier. Though not perfect, these procedures are the most reliable option given the circumstances—which isn't saying much. ID systems are most commonly implemented by the authorities of the inner system, though even autonomists have use for them. Extropians use ID systems for the myriad of contractual agreements they engage in, the Titanian Commonwealth requires citizens to identify themselves to participate in the Plurality, and even anarchists adopt ID systems for simple identity management and security (such as protecting their backups).

Brainprints

Brainprint scans are considered the definitive method for identifying egos. Contrary to popular misconceptions, the term "brainwave scan" is a misnomer, as this form of identifier is not based on simple electroencephalography (EEG: a reading of the electrical activity created by neurons firing within the brain). The actual process for recording brainprints for identification purposes goes much deeper than that. It is based on the electrophysiological responses (event-related potentials) to invoked sensory stimuli as well as deep background neural activity measured by magnetoencephalography (MEG) and correlated between different regions of the brain. Controversially, this deep scan of the mind's default network activity is considered by some philosophers and psychosurgeons as the "true self," the unique thing that defines us as individual persons.

The process of recording a brainprint takes roughly an hour to systematically map out the core underlying structure and results in an unique identifier for each biological brain. There is one challenge to brainprints, however: they change over time. Transhuman brains are high-plasticity organic devices that incorporate new memories, suffer trauma, build new synaptic structures, and otherwise undergo changes. Luckily, these alterations only impact the core underlying structures identified by the brainprint in slow, incremental measurements. This means brainprints must be updated for accuracy on a roughly yearly basis. In practice, brainprints are usually updated each time a person undergoes a regular backup or uploads for egocasting.

Conducting a full deep brainscan "in the field" is impractical given the equipment and time required,

decreasing its utility for security checkpoints and mobile police stops. To check that a person isn't someone other than who they claim to be is a simpler affair. Police or security personnel can conduct a five-minute test using portable equipment to verify an ID. This portable brainscanner consists of a skullcap that is placed on a biomorph's head, which then extrudes ultra-sensitive nano-electrodes into the scalp. A visor and ear plugs feed a sequence of images and sounds while the skullcap also applies tactile sensations. The cap measures the brain's response to these stimuli and compares certain markers to the brainprint of the person provided in a secure ID database. Assuming no major deviation (or no deviations beyond the accepted rate of error), the brainprint is verified. Because this quick brainscan test is not fully accurate, it is not unknown for it to occasionally fail, particularly if a subject has recently undergone mental trauma, psychosurgery, or manipulated their brain with drugs or narcoalgorithms. Common procedure for failed field verification is to place the subject through a full brainprint analysis scan.

Scanning the brainprint IDs of people sleeved in pods or synthmorphs or existing in an infomorph state works a bit differently. Since there is no biological brain activity to measure, the individual's software brain state must be accessed (requiring a direct connection via access jacks or software plug-in). The emulated brain state is then fed a sequence of diagnostics input, producing output that roughly models the measurement of a biological brainprint. The advantage to running this test via software is that it proceeds far more quickly than biological scans, taking only a few seconds to verify the key markers as with most field tests. In the five minutes it takes to field test a biological brainprint, a tester can map out a pod, synthmorph, or infomorph's brainprint as throughly as a full hour-long biological scan. Despite the ease of such testing, most checkpoints rely on the even quicker method of checking the ego's digital code (and its cryptographic signature) for simple verification.

It is worth noting that the unique nature of AGI brain states means that they are quite easily identifiable from biologically born and grown human brains. It is a simple measure to recognize an AGI ego with a brainscan field test. For this reason, AGIs that are sleeved in biological or synthetic morphs and not broadcasting their nature still tread carefully in habitats where AGIs are frowned upon or suffer discrimination—or worse yet, are illegal. Uplifts face a similar issue, particularly non-hominids, as their brainprints also provide tell-tale signs of their true nature.

Digital Codes

Digital egos are almost universally stamped with a digital code whenever they are created. This code is created by the entity/device that generates the digital ego, whether it be a backup or infomorph. Each code is digitally signed with a cryptographic hash, allowing it to be verified against databases online. Whereas this process is legally mandated in the inner system polities, it is a common procedure in the outer system as well to protect against identity theft.

Digital codes almost always include a copy of the person's brainprint. This enables easier verification when egocasting and resleeving.

It is standard for AIs and AGIs to have digital codes embedded in their coding by default, though there have been exceptions with software intelligences created by criminal groups, exhumans, and some autonomists and mercurials.

Nanotat IDs

Nanotat IDs are created with specialized nanobot swarms, implanting an information-laden nanotat design on the index finger of both biomorphs and synthmorphs. Nanotat IDs are encoded with the user's brainprint and other identifying information. Nanotat IDs are required in almost all inner system jurisdictions, though autonomists also use them for easy identification purposes.

Nanotat IDs are implanted when the person sleeves into the morph and are usually encoded with all of the information required by local laws or whatever information the person desires in more lax jurisdictions. The body bank relies on the digital code embedded within the ego when verifying identities before nanotat imprinting.

Mesh IDs and Online Accounts

In many senses, the mesh ID assigned to each person also acts as a unique identifier. Given that most transhumans are constantly meshed, often for months at a time without interruption, mesh IDs serve as a connection point linking together their mesh activities and online social profiles. Though easily faked and obfuscated, mesh IDs can unlock a treasure trove of data about someone's interests, activities, physical presence, communications, and much, much more. The footprint left by this activity has been used in some legal cases as a proof of identity, and there is no denying its value to spies, marketers, and private investigators. The same is true for the online accounts each person uses to access various sites and social networks. Many people, in fact, are more well known by their online account handles than by their actual identities.

Other ID Forms

Though less common, other ID systems may be implemented by certain authorities, hypercorps, or other groups. The Jovian Republic, for example, with its large population of flats and opposition to resleeving, does not rely so heavily on brainprints and nanotats. Instead, implanted wireless ID chips and biometrics remain the primary identifiers in Jovian

habitats, particularly iris/retina scans, palm prints, and facial recognition scans. In more secure Jovian facilities, more sophisticated measures may be used, particularly if there is any concern about infiltration by non-Jovians. Among certain infomorph mercurial societies, unique crypto keys are used as personal software identifiers.

Resleeving, Travel, and Egocasting

Whenever a person stops in for a backup, resleeving, or an egocasting upload, common procedure is to check the customer's identity, verify and update their brainprint, and embed their digital code in their infomorph state. In black market and some brinker and autonomist circles, these procedures are often waived or bypassed; in such circles, your identity is whatever you want it to be. In more law-abiding areas, these procedures are mandated by force of law and the hypercorp or organization providing the services can be held accountable for ID verification. To verify the IDs provided, body banks and egocasters will run the information against whatever local databases are used for such purposes. Sharing ID data between habitat authorities and distinct polities is the exception rather than the norm, however, meaning that it is often impossible to fully verify the IDs of individuals originating from foreign colonies.

Likewise, whenever someone arrives at a new station, whether physically or egocasting in, they can expect their ID to be verified in an even more thorough manner, assuming they go through normal channels. Almost all habitats, even anarchist holds, like to keep a careful roster of who is present inside for safety and security reasons. Depending on the authorities governing a particular checkpoint, the thoroughness of this ID verification can vary drastically. When it comes to egocasting, aside from whatever local databases they have to check against, security is often forced to rely on the verification of the services that uploaded and cast the ego over.

Naturally, habitat authorities are often suspicious of egos originating from a habitat owing allegiance to another political entity. Many egocasting receivers have a filter in place that flags egos arriving from untrusted sources. These egos may be forced to go through extra ID verification, which usually entails running their brainprint through a more thorough and exhaustive database list. If they are unlucky, the ego may be shunted into simulspace to undergo psychosurgical screening, or may be assigned limited visitation visas that restrict their activities or place them under increased surveillance. Authorities that go messing around inside people's heads too regularly are viewed with suspicion and hostility even within the inner system, however, so more invasive screening is typically reserved for those who have already raised eyebrows.

The intersection between autonomist zones and traditional habitat governments remains a sore spot. Inner system authorities rarely trust the digital codes

ORIGINAL PHENOTYPE: NEO-CETACEAN
GENDER IDENTITY: FEMALE
SEXUAL PREFERENCES: POLYSPECIES/POLYSEXUAL
HOME: EUROPA
INTERESTS: ROPE PLAY, ECONOMIC THEORY, HISTORICAL FEMINISTS, FISH [MORE]
C REP: 27 [INFO]
@ REP: 64 [INFO]

and identity authentication transmitted with egos from autonomist stations. As a result, outer system travelers must usually go to some lengths to register and verify their identities with approved authorities if they wish to avoid hassle. Similarly, while many autonomist habitats do not restrict immigration, they often have policies requiring hypercorp, government, or military personnel from other polities to publicly identify themselves or face censure.

Hypercorps engaged in egocasting operations such as Nimbus, eGo Travel, and Mindjump build their reputations by verifying identities at both ends of the transmission, in effect becoming trusted identification vetters for many habitat authorities. Others scrape various sources and mesh services for data and sell subscriptions to brainprint and identification databases. These private commercial databases are often used by habitat authorities that need to check out someone more extensively; said person is usually stuck with the bill for this ID validation as well. In Extropian habitats, ID-trust hypercorps make a business out of identity verification in place of governmental institutions.

If a person physically travels to a new location, rather than egocasting, it is entirely possible that their nanotat ID will not meet local requirements. Most customs checkpoints will do their best to verify the ego's identity, erase the old nanotat ID, and implant a new one.

THE SAPIENT INITIATIVE

"With adoption of the SAPIENT system, the confusing array of different legal recognitions will finally have a coherent thread, and we will have a powerful tool to combat the growing problem of identity theft that threatens the security and emotional safety of the public."

—Desideria Perestrelo, Special Secretary on Social Justice, Lunar-Lagrange Alliance, in a speech to the Consortium's Planetary Congress

Begun in AF3 as a response to the massive social confusion in the aftermath of the Fall, the Self-Aware Personality/Intelligence/Ego Novel Tag (SAPIENT) Initiative was an effort by the Erato colony government on Luna to consolidate and organize personal information for refugees. Lacking the resources to verify identity claims, particularly for newly sleeved infugees, social services and local government were struggling under a rash of lawsuits from credit account property heir claims to indenture contract disputes. Attempts to coordinate ID information and verification between habitats repeatedly broke down and suffered from ongoing political disputes.

Grown out of sheer necessity, SAPIENT was the first ID program to gain widespread traction among multiple habitats and has since grown into a significant interplanetary socio-legal network. Various Lunar-Lagrange Alliance habitats were early adopters, with several Consortium-aligned colonies also signing up to ease the transition of their own infugee populations. Despite official endorsements by both the LLA and Planetary Consortium, and even implementation by most of their aligned habitats, neither political bloc enforces the initiative on their members. While some habitats rely solely on SAPIENT, others employ it in coordination with their own private systems. More than a few stations refuse to work with the network out of principle, stating either a desire for local procedural autonomy or disagreement with the initiative's standards (notably, some habitats refuse to acknowledge the legal standing of uplifts and/or AGIs, which they claim the initiative enforces). It is not uncommon for private sole hypercorp-owned habitats to rely on their own ID systems as well.

There is currently a major push in the inner system to have all major polities and habitats adopt the SAPIENT ID program as a common transgovernmental personal identifier. Proponents argue that it defends against impersonation, establishes a common standard for fork identification, allows for a smoother transition of infugees back into society, increases security by making it harder for criminals and subversives to operate, and saves time and resources for all authorities involved. Various uplift groups have spoken in favor of the project, as it further enables their recognition as citizens and provides them a modicum of legal protection. The Consortium's Oversight is also lending its weight to the initiative as an effective tool for countering external threats and corruption. Detractors claim that it impinges on personal freedom by providing no opt-out option from the data sharing between habitat and commercial organizations and creates a system where habitat governments would be forced to recognize some egos differently than they would like. Some postulate wilder suggestions of hypercorp, Factor, or TITAN conspiracies.

SAPIENT has widely been rejected by Morningstar Constellation affiliates, though the Venusians are laying the groundwork for their own alternative. Though some outer system habitats have signed up, none of the major stations have. The Jovians already have an ID system of their own (with a much heavier emphasis on biometrics), the Titanians have a lightweight system for their Plurality, and most anarchists and brinkers scoff at the notion. For some, the idea of being tracked in a universal system simply offends their sense of individual rights. With the current ability to change who and where you are at a moment's notice, an immutable marker of their identity beyond their control is appalling. Isolates frequently espouse this view, though some philosophical adherents to multiplicity and individualist memes feel the same.

OPTING IN

"It will make record-keeping much easier, our demographics division will get much better customer data,

Proxy A: I don't think there's any question whether we should consider SAPIENT problematic. Operational challenges aside, we lose people every day trying to find, catalog, and quantify the x-threats that are out there. You don't think they're trying to do the same to us? I don't give a toss for intentions; we need to stop this now unless we want to give whatever is going to come after us next a to-do list for snuffing us out.

Proxy B: Personally I think that line of reasoning borders on paranoid fringe ranting.

Proxy C: Extreme, perhaps, but there is a valid concern here. Centralization has its drawbacks. Currently personal activity is split up over a bewildering array of personal and public networks and databases. Although it is still possible to hack and track almost everything someone does, it requires a great deal of time and attention as well as going through the security measures of each system in turn before the data can be brought back to any shared identifiers. If the SAP ID # were to become more universal, it would become much easier to track an individual's activity as their SAP ID use would provide a common thread for searching and spoofing attempts.

Proxy A: Authorities that opt-in to the SAPIENT project would have to share data and therefore increase permissions between their own proprietary and heavily defended networks and data centers. That effectively creates one more avenue of attack in the event of any hostilities. It opens the route for a serial infection, where a virus or digital attacker moves from one compromised system to another.

Proxy B: But if we're talking something on the level of the TITANs, we're already talking about a threat with the capability to infiltrate multiple secure networks quickly and easily.

Proxy A: Well, why would we make it easier for them? It's simply too risky to consolidate that much data. Centralized networks and databases were one reason they were able to bone us the first time around; we shouldn't replicate that sort of weakness again.

Proxy C: There are other concerns aside from the TITANs. The strong Planetary Consortium involvement in the SAPIENT Initiative raises fears about possible misuse. There are already reports that SAPIENT has been manipulated to track and "disappear" undesirables. And just think what an outfit like Project Ozma could do with those resources, using it for probabilistic or predictive surveillance against autonomist or other oppositional elements. There are many potential vectors for abuse.

Proxy B: Are you also considering what use it might be to us? To Firewall?

Proxy C: Oh, I have, I have. Do you really think we are any more worthy of trust with such capabilities? We must always consider the possibility that we may be a threat to transhumanity ourselves.

and we can get favor with the pols for early adoption. The only thing I don't like about it is that we didn't come up with it first."

—Xue Dingxiang, EVP of Marketing, Solaris

For the majority of transhumanity, the SAPIENT program offers a way to better organize information and protect oneself from identity theft. Years of living with and actively participating in comprehensive surveillance have changed expectations. A system to unify the current patchwork of ID databases into a cohesive and simple format is seen as a social good. As the majority of the transhuman population already lives and works in the inner system under Consortium and LLA banners, the SAPIENT Initiative is widely viewed as an inevitability and debate focuses on specifics of implementation.

Though there are social issues regarding citizenship and personhood rights for uplifts, AGIs, and forks, most see those as problems to resolve rather than reasons to oppose the program itself. On Luna particularly, the program is seen as a huge opportunity to organize and better catalog the millions of egos still in cold storage from the Fall. Assigning all inactive egos a static SAP ID and entering it into the general database allows for easier identification of friends and loved ones for rescue, a way to avoid abuses of indenture where copies of one ego are sold to multiple parties while the original is kept on ice, and a sound legal start to personhood for newly instanced infugees.

ID PROBLEMS

Though there are astounding amounts of data produced and gathered on each individual, the information sets generated are rarely correlated, a fact that imposters and identity thieves constantly exploit. In fact, identity theft remains a major problem, particularly in the inner system. Several criminal cartels, particularly the ID Crew, specialize in penetrating ID databases and selling that data on the black market in remote corners of the solar system. It is not uncommon for someone to find out that their data has been used to establish a fake persona in another polity, and it can be even harder to get such impostors removed. Even more effectively, digital codes are sometimes cracked and copied or brainprints are stolen and emulated, creating fake alter egos that are even more resilient. This is particularly troublesome when combined with forknapping, as detained forks can sometimes be abused to verify an impostor's activities as legitimate. Stolen or copied brainprints can lead to major difficulties as you cannot get a new brainprint without major psychosurgery that effectively changes who you are.

Identity theft is used for many purposes. The most common is to bypass authentication in order to access someone's personal credit accounts, private networks, and social network profiles for theft, spying, or blackmail purposes. They are sometimes used to establish legitimate businesses and accounts that underworld groups employ as a front to mask their secret activities. Spies and other undercover operatives use them

as disposable cover personas while they go about their work. When employed on a mass scale, they can be especially effective. Fake IDs are sometimes used en masse for political astroturfing campaigns (faking a grassroots movement in support of a political actor's goals) or as sock puppets to promote more personal agendas. They may also be used to sabotage or game someone's rep score—a common claim in certain political arenas, especially during heated elections. Some theorists speculate that particularly sophisticated ID thieves have entire automated networks of fake IDs that they use to establish legitimacy for other falsified personas before they are used or sold to others.

Privacy advocates consider ID information to be a thorny privacy issue. They point out what little control people actually have over their ID profiles that are stored in various private, government, and commercial databases and the lack of recourse those people have for correcting information that is false or incorrect. Many databases are known to be riddled with errors, often causing confusion between people with overlapping details. ID profiling is also cited as a concern in various restrictive polities where police and security personnel are often more prone to target AGIs, mercurials, or people with particular backgrounds for extra screening or even discriminatory or abusive behavior.

ID Protection

Many transhumans use the tools of surveillance to their advantage and instruct their muse to monitor local mesh feeds for any indications of identity crime or unauthorized fork activity. Some go even further and employ dedicated scanners (usually simple AI agents, but sometimes freelance infomorphs) to station themselves in the mesh nodes of other major habitats to monitor for identity theft. Numerous hypercorps provide this service at reasonable rates; high-end options exist that monitor transactions and activities in the larger commercial and private databases as well. An Extropian hypercorp known as Persona+ has extended similar protections to autonomists, extending branch offices in various outer system habitats. Their efforts to monitor inner system networks on behalf of their clients have suffered from Consortium-enacted roadblocks and an outright smear campaign launched by Stellar Intelligence.

ID and Forking

Identity gets a bit tricky when forking is called into play. Alpha forks have the same brainprint as each other, at least at first. For legal purposes, most jurisdictions treat alpha forks as the same person up to a certain time period of divergence (4 hours being common in the Consortium, but ranging up to a day or even a week in some habitats) or alternately treat the originators as legal guardians of their alpha forks (and thus legally responsible for their actions). Cognitive scientists disagree over how long it takes and what makes a fork a distinct personality and therefore a separate ego, and so the legal standing of forks varies even more than AGIs and uplifts. In some polities (notably many Consortium stations), alpha forks that diverge beyond a set period become legal non-entities with no rights unless specifically "emancipated" by the originating ego. This policy neatly side-steps property claims and inheritance issues, but it does sometimes leave alpha forks open to discrimination or even murder (defined as "termination" by this viewpoint) without consequences. In others, non-merged forks become full but separate citizens. Most habitats require forks to be identified as such in their digital codes and nanotat IDs; if the fork becomes a separate legal entity, it is of course granted a separate ID. Alpha forks that diverge from their originators will still register the same brainprints for up to a year and sometimes more, however, creating occasional legal entanglements.

The situation is even hairier for beta and delta forks. These forks do not register the same as their originating ego on brainprint scans. With the exception of a few extremely liberal jurisdictions, they are universally considered property rather than separate

Identity Monitoring

PersonaNoctis12: Hi SnackBoi, this is a clarification check from your Persona+ monitoring service.
PersonaNoctis12: Have you traveled to Luc's Cluster on Ceres in the past 3 weeks?
SnackBoi: No, I've never been.
SnackBoi: What's up?
PersonaNoctis12: One moment please.
PersonaNoctis12: Persona+ has detected unexplained activity under your good name!
PersonaNoctis12: A verdict of Guilty: Aggravated Felony Property Damage to Habitat Systems has been entered against you!
PersonaNoctis12: Sentence of VR Conditioning and Reparation is pending your arrest. Three separate ego hunter firms have logged their intent to pursue.
SnackBoi: WTF?!
SnackBoi: I haven't been off Extropia in over a year!
PersonaNoctis12: We are sorry for the bad news. Unfortunately your current Persona+ service level does not include remediation services. Would you like to meet with one of our counselors to discuss additional ways we can assist you? Select yes to enter Persona+ simulspace for a free consultation.

sapient beings and so have nothing in the way of individual rights. Even in autonomist circles opinions vary; most anarchists treat beta forks the same as weak AIs—as things, not persons, and delta forks even more so. A small but growing number of colonies, particularly in the outer system, consider beta forks to be unique persons with the full rights and privileges the progenitor ego enjoys. Like alpha forks, beta and delta forks are almost always required to make their nature known in digital codes and nanotat IDs.

New technology that looks at psychographic data is being developed for behavioral surveillance that establishes personality norms to help verify identity in case of forking or imposture. These procedures are not considered reliable or practicable yet. Some of the parties involved in research, including Cognite and a joint research venture between Titan Autonomous University's Individuality Studies faculty and the University of Mars Cognitive Science Department, have come under criticism for their methodology, which has involved invasive cortical stack procedures and similar steps considered to be an invasion of personal privacy.

Panopticon Issues, Ethics, and Culture

Posted by: Zim Shirky, Outreach Coordinator, Electronic Futures Foundation <Info Msg Rep>

The historians say that we sleepwalked into a surveillance state. They meant that the technology for widespread surveillance progressed and was implemented in a gradual manner, though quick considering the actual time scales, and with little in the way of open discussion about the ramifications, so that before anyone thought to object it was already ingrained into society. When the tables turned and the same technology was used to watch the watchers, there was a bit more resistance, but by that point the genie's bottle had already been melted down and reshaped as a camera lens. By the time the pundits broke out their talking points and started debating the issues and repercussions, a new equilibrium had already developed. As usual, the conversation was framed in a way to distract people, to keep them endlessly arguing over the same points.

Privacy vs. Transparency

The main issue, at least according to the memeticists of the inner system, is the tension between transparency and privacy. Transparency, we are told, is essential for safety, security, and accountability. By always being able to check in on or track our loved ones, from any place at any time, we can rest assured that nothing bad has happened to them. If an accident were to happen, most likely some watcher somewhere would notice, and so help would soon be on the way. With many eyes watching, we can feel safer from crime, terrorism, and other potential dangers such as fires or life support malfunctions. Likewise, in a transparent society, the argument goes, no one has secrets. You know everything I do, but I know the same about you. We are all accountable to each other. The regimes of the hypercorp governments play to this to the hilt, noting that even governments are accountable to their people. Monitoring citizens can catch abuses of power, violations of rights, or unethical activity. The government watches the people, but the people watch back. Among the autonomists of the outer system, similar arguments are often applied. Universal sousveillance protects everyone, allowing everyone to keep an eye on each other, thus leveling the playing field.

Those who argue heavily in favor of sur- and sousveillance often argue that privacy is a thing of the past. In their view, if you're doing nothing wrong, you have nothing to hide.

This is a gross simplification, of course. If you watch someone long enough, you will eventually find some reason to arrest or blackmail them, if that is your goal. But that is not even the point. Transhumans have many good reasons for personal privacy that has nothing to do with hiding illicit or illegal activities—some, in fact, define privacy as a civil right or inherent human need. We expect and need privacy for our peace of mind, for our intimate moments, for composing our own thoughts and reflections, for sharing confidentialities with partners, for managing our own disabilities and personal shortcomings. There is nothing wrong with expecting or even demanding privacy for certain aspects of your life. Some would consider it an essential element to maintaining our own dignity. Secrecy is also important for innovation and business relations.

Sometimes, of course, there are disagreements about what may be considered "wrong" to the society at large. In a station where anti-uplift prejudice is common, a mercurial may rightly feel justified in keeping its identity and affairs private for fear of discrimination or persecution. Many of us would consider this undeniably just, no matter that the uplift in question might be violating local laws—especially if we had to go a day sleeved in their morph. Likewise, a dissident who organizes against or even actively sabotages an oppressive or authoritarian regime has a reasonable need for secrecy, which the government would undoubtedly dispute. To many of us in the outer system, all capitalist governments are oppressive. Privacy in such circumstances is a requirement for survival.

In truth, ubiquitous surveillance and privacy are not mutually exclusive. The question is simply where the line is drawn. Even in today's societies of omnipresent watchers, a distinction is often made between the public and private sphere. Allowances are made for people to maintain privacy in their own homes and offices. Our bedrooms, bathrooms, workshops,

and boardrooms are off-limits to outside eyes. In less restrictive habitats, it is even acceptable to maintain a semblance of privacy and anonymity in public, via the use of private mesh modes or even privacy veils.

Power Dynamics

In my opinion, the inner system talking heads are pulling a fast one. The choice is not really between transparency and privacy, it's between liberty and control. As any autonomist worth the name can tell you, you can't debate surveillance without talking about the vast differences between people with power and those without it. Complete transparency is worthless as an equalizer if a significant portion of society lacks the ability to do anything with it. This is an important lesson the citizens of the inner system have yet to fully comprehend.

Consider some examples. When a habitat security contractor stops you to verify your ID, you are at a disadvantage. You may be able to access their name and ID as well, but the best you can do is maybe pull up some personal info on the mesh, check their social network profile, or see if their name has cropped up in the newsfeeds. You may be able to dig up some personal history and even track them online—but what would you do with that info? The security guard, however, can run your ID against multiple government and private databases to which you don't have access. They can pull up private details such as your arrest history, citizenship records, and all manner of private personal details. They also have the authority to detain, question, and arrest you.

Let's say the situation is more drastic. Perhaps you catch the security officer in the act of beating someone who is not resisting. You may catch that on video, spread it around the mesh, and maybe even cause charges to be filed. Ultimately, however, the security guard is likely to get a slap on the wrist or go unpunished because they are part of the power structure and those within that structure protect their own. Meanwhile, you have just made yourself an enemy of the security and political apparatus. You may find yourself harassed or targeted with violence. Perhaps the video you enter as evidence is determined to be doctored. Perhaps the authorities pull out their own video proving that you instigated the fight, thanks to their ability to fabricate whatever evidence they need.

This is why the "transparent society" of the inner system is a pipe dream. Without equality, transparency is meaningless. Since the Fall there have been untold instances of scandal involving people of power and wealth, but very few of them pay for their crimes in the end. Their influence gives them the means to warp due process and receive special treatment. Remember that hypercorp dynasty brat on Luna who was found to be an uplift serial killer last year? Never convicted, despite hard evidence. The elites and their tools have a special coating that allows them to deflect minor crimes and wrongs. It is the nature of privilege. Scandals and leaks catching such figureheads in the act are so common as to be routine and boring. Their impact is routinely blunted by cynicism and apathy. The public's attention is quickly diverted, and no one really expects them to be punished anyway. With the resources at their disposal, most of the powerful have learned carefully how to shield their more heinous crimes and activities from view. Extraordinary power requires extraordinary transparency to undermine, and the elites have not let sousveillance creep that far just yet.

This isn't to say that transparency has no effect on non-egalitarian societies. Leaks and the accountability forced by transparency function as a sort of "secrecy tax" on those in power. The more secrets they keep, the higher the cost they pay to protect those secrets or recuperate when they are made public. This has an effect to push the elites towards more transparency simply to defray costs of operation. The tension comes when this transparency begins to threaten their control. Many governments attempt a balancing act, practicing openness to a point and risking secrecy for the true behind-the-scenes power players. Many are exposed and pay the price.

A true participatory panopticon requires a society of equals. This is how the autonomists function. An injustice or antisocial act caught on video in an anarchist or technosocialist habitat will earn the wrongdoer the disdain of their peers, measured as a drop in their reputation in proportion to the offense. In a pluralistic society, peer shaming has great power. Offend your fellow beings too often and you may find yourself subject to censure or outright exile. While the word of someone with a higher rep may deflect some of the force of an accusation from someone with lower rep, reputation does not translate into power as it does in the inner system. Even high-rep people can expect to pay a price if damning evidence of gruesomely inappropriate behavior is shared across a habitat's mesh.

Information Control

One of the main issues in power dynamics is who has control of the information? When cameras are seeded throughout public areas of a habitat, do only the authorities have access to them? Are the cameras owned by private companies who sell the feeds? Or are they open to all via the mesh? What about cameras in government buildings? Police stations? The same questions may also be applied to consumer data, to various databases, and to information supplied to social networks by their users.

The more open and decentralized such information is, the more liberatory the society. In an autonomist habitat, the cameras outside of private residences are open to everyone and databases are public access. In inner system and Extropian stations, open publicams and databases abound, but there are also many private cameras and archives—often of superior

quality—to which you must buy access. Thus the wealthy have more access. In the colonies of the Jovian Republic and similar restrictive polities, public cameras and databases are limited, but the watching eyes of the authorities are everywhere.

The standard playbook for authoritarian regimes when dealing with information they don't like is to try to contain or censor it. In many of today's habitats, the decentralized mesh and access to QE comms or darkcast networks makes this an impossibility. Censorship is rarely successful, though it is occasionally still tried. AI botnets may be released to scour unwanted data from public sites. A more effective remedy, as many autocrats and oligarchs have found, is to wage disinformation campaigns. When you cannot hide the data, make it unreliable, or bury it under a wave of counter-attacks and spin. Censorship and mesh blockades still have an impact in tightly controlled stations, such as the Jovian Junta's colonies or private hypercorp habitats.

Among the capitalist societies, a related question is not just who controls the data, but who owns your personal data. Average citizens supply their personal data to numerous social networks, cloud services, and other mesh sites on a daily basis. Their personal transactions and mesh activity are logged and recorded by marketing corps. With few exceptions, they have no control over how this data will be used or to whom it will be sold. In many cases, they may not even be aware it is being collected. Even if they are, the social cost of not using such services is too high—opting out has its own price. Though some polities have enacted restrictions on data retention, require opt-out policies, or otherwise limit the manner in which such data is collected and used, it is rare for consumers to have much in the way of protection. This raises an uglier set of questions when you consider that these data archives can be mined by restrictive governments, political parties, or others looking to gather information on criminals, dissidents, opponents, or simply people they don't like.

ACCOUNTABILITY

Where power intervenes, transparency fails to provide accountability. This is the main fact that the residents of the Planetary Consortium and their ilk must grasp. Public-accessible cameras and citizen sousveillance of police is not enough. To truly hold the people at the top accountable, publicams should be placed inside police stations, interrogation rooms, jails, security checkpoints, congressional chambers, and anywhere government officials meet with lobbyists, make decisions, and otherwise exercise their authority. Recording the police and government should not only be legal but required. Officers, politicians, and civil servants should be required to lifelog their activities, record all meetings, and broadcast their affairs. Budgets, expenditures, and contributions should all be logged. As public servants, they should be held even more accountable to the public than our neighbors and peers. And the only way the public can hold them accountable is if the public is informed.

To varying degrees, this does occur. Planetary Congress debates are one of the great spectacles of the inner system. Many congressional persons lifelog or at least X-cast their office hours. Yet the Consortium's Ministry, Assembly, and Hypercorp Council are not open in the same way. The activities of the true government power remain shielded from prying eyes.

How is this secrecy justified? Security, of course. According to the party line, essential government affairs must be veiled to protect them from hostile interests. The same logic is also applied to diplomatic relations, military matters, and sometimes even economic affairs and trade agreements. The authorities, of course, decide for themselves what matters are critical to security, without public oversight. These officials have been elected or appointed and the public should trust them to do their duty, or so we are told. To open up all political business would be to expose weakness to rival foreign powers, not to mention provide fuel for endless partisan bickering. If privacy is an individual right, they say, why should officials not also have it?

To an autonomist, this is a failure of accountability, and perhaps underlines a fundamental distinction between inner and outer system ideologies. The inner system relies on representatives who are given authority to act in the public's name; they are expected to represent the public, but ultimately the decisions they make are their own. Among autonomists, delegates are used for representational purposes, who have only the authority to pass along the decisions made by those they represent. To ensure this, the activity of delegates is transparent and held accountable. If a delegate were to misrepresent their constituency, they would be recalled immediately—no waiting for the next election.

An essential element of accountability, both in personal and political affairs, is criticism. By exposing ourselves to the public eye, we open ourselves to critique from all angles. This enables more opportunities for dialog and exposure to opposing views. It also serves as an organic error-correcting mechanism—no one goes long after making a mistake without someone telling them about it. Watching others make mistakes is also how the rest of us learn. Accountability is not just about keeping each other in line, it's about self-improvement of the collective organism.

Anonymity and Infamy

If you accept that privacy is a fundamental right, then a fully transparent society must also allow for anonymity. Privacy is not solely something to be exercised in our homes. Sometimes privacy is wanted or needed while interacting with others in public. A person tackling a drug problem, for example, may wish to attend recovery meetings without facing shaming from their peers. A young adult raised by prejudiced parents may wish to spend time with a best friend, who happens to be an uplift. Two lovers may wish to enjoy each other's company without seeding gossip among their joint co-workers. A person considering a new sleeve may choose to shop through their options in person, privately, to consider the decision before they are pressured by their friends' opinions. Perhaps you simply want to voice your political opinions or criticize someone powerful online without fear of backlash. Perhaps you simply need some time to yourself, to walk the streets without the attention of others. There are many legitimate reasons to operate in private mesh mode or to cloak your affairs online.

The risk of anonymity is that it has no accountability. When someone makes claims from a veil of secrecy, there may be no way to verify the source. When someone slanders another from an anonymous account, there is no redress. Criminals and terrorists may abuse anonymity to break the law. Mesh anonymity is sometimes known to bring out worse behavior in people, as they feel comfortable flaming others and griefing behind their unknown identity. Some societies consider anonymity to be taking privacy interests a step too far and either restrict or outright outlaw it. Others consider it an integral component of private life, a necessary counterpoint to the ubiquitous transparency that envelops us.

Pseudonymity provides a comfortable middle ground in some cases. Some people maintain all of their public activity behind the facade of a nom-de-guerre. Others split their lives among different arenas, operating under different personas for each. Though pseudonyms can be abandoned, they do provide some level of accountability when sustained over time. Many people become so attached to their false identities that they are reluctant to abandon them.

On the opposite side of the scale is a phenomenon predominant among celebrities and famous figures: infamy. More than anyone, celebrities draw the public's eye and are accustomed to living life under a microscope. As a result, they often have more to lose by acting gracelessly or improperly. Some, however, obtain a footing where they are known as bad boys, girls, or things. Because the public becomes jaded to their misadventures and expects them to trip up, cause a scene, or otherwise cram their tentacles in their mouths, they become partially immunized against losing more rep. In many cases, crimes or scandals have actually increased their reputation, solidifying their crafted image as a rogue character. The smart ones build on this to boost their public image, staging dramatic events to expand their infamy.

Truth vs. Fiction

According to a common maxim, you should never believe anything you see or hear on the mesh. In an age of sophisticated image, video, sound, and even sensory manipulation, the veracity of information online is indeed suspect. As a result, images, video,

and other sensor recordings are rarely accepted as final proof or evidence without verifiable metadata or other corroborating information. That said, most images and recordings are usually taken at face value when first viewed, unless their content is remarkably suspicious. Only later are they verified—if it matters. This means deceptive media is very effective, at least in the short term. This means that even in a transparent society, voyeurs cannot always trust that what they are seeing is real, at least until it is verified in other ways.

While falsified media is often used to temporarily cover one's tracks, at least for a short period, fake data is often more persistent. This is perpetuated by the fact that many archives and data sources share information with each other without fact-checking, so incorrect data can be seeded far and wide. Though much of this information is simply a mistake, incorporated by bad transcription software, mis-matched database relationships, or simply faulty record-keeping, there are groups that actively seed disinformation on purpose. These hackers may simply be laying a cover for the organization for which they work or they may be sowing lies on general principle, to make the pervasive databases that much more unreliable. Falsified records can be especially harmful given that they can be next to impossible to clear up. Few government and corporate databases have clear methods for reporting and correcting errors, even for matters such as credit reports and security watch-lists. Some citizens have found out the hard way that wrong or intentionally faked data can hound them for the rest of their lives.

Beyond media and data, it is not always safe to assume that other mesh users online are what they seem. Sock puppets and astroturfing are common practices made even easier by AIs and forking.Memeticists, propagandists, and griefers have turned the manipulation of online discussion into an art form, sometimes employing vast networks of coordinated fake personas. These networks are even used to build the reps of individual personas, to make them seem more authentic. Though various methods are employed to guard against these measures, sock puppeteers are devious and often find ways around them.

What this means is that an open society is often more muddled than it seems. Important debates are sometimes drowned out by the most numerous voices—or the bigger puppetnet. The stranger you are dealing with online may be an entirely fabricated persona. Checking reputation is not always enough.

Surveillance Insecurity

Universal surveillance is touted as important for security, and it is, but it is important to keep in mind that transparency brings about its own vulnerabilities. On a personal level, when everyone knows your business, you become an easier target for enemies or even run-of-the-mill criminals. Thieves may target your goods while you are away, con artists may exploit your personal history in elaborate schemes, a serial rapist may target your morph as their next victim, or someone you owe credit to may track you down to break your legs. The more personal data is available about you, the easier victim you make for identity theft. The more information about your habits and personal details you let fall into marketing hypercorp hands, the more likely an unscrupulous corp will target you with directed scams.

For anti-authoritarians, a more pressing question is the capabilities our surveillance society gives to the authorities. The police and security contractors almost always have access to more surveillance assets and info archives than the public. They likely have the ability to track you wherever you go and analyze in detail whatever you do. Should you be considered a dissident, activist, criminal, or even just an undesirable element of society, you are easily within their means to be tracked, watched, and messed with. This is the peril of an open society. On the positive side, the cameras may look both ways, to varying degrees.

The government and criminals are not the only potential threat, of course. Omnipresent sur- and sousveillance could be used by almost any hostile agency, from rival political factions to corporate competitors to everyone's favorite: the TITANs. This is a risk that we take, that the tools we implement for our own collective security can be turned against us. This is yet another argument that these tools should be fully democratized, shared, and open—the more watchers, the quicker a response can be made when someone does take hostile action.

Crypto Security

In societies with heavy data and comms surveillance, crypto systems are seen as one of the only methods to maintain digital privacy. When implemented properly, crypto systems can be very effective at safeguarding personal files or communications. There are risks, of course. Using cryptography can itself be seen as suspicious, implying the user has something illicit to hide. In more restrictive habitats, crypto is criminalized; the authorities do not want you to have the tools to evade their prying data-crawlers. Crypto is also engaged in an arms race with code-breaking technologies. If you misuse your crypto tool sets or fall behind the state of the art, your encrypted secrets and transmissions may not be as protected as you think.

Cultural Openness

Aside from all of these weighty matters, the cultural effects of living in an ultra-surveillance society are an interesting phenomenon. There's a certain liberation to always being on record. Everyone sins. Accepting this simple fact means that unless you do something absolutely ludicrous, you're not standing out as the only one doing something wrong. This creates a

domino effect of mutual understanding. In a universally watched culture, many barriers and taboos are broken. Cultures and subcultures that once seemed foreign no longer seem so weird or unusual when you realize that their constituents are not all that different from you. People cease to care about who may or may not be watching. Hedonism and more open displays of sexuality become a daily standard—sometimes to the chagrin of the conservative elements that were the strongest proponents for full surveillance. Cultures that once tried to shield their members from certain concepts or realities no longer have the capability to do this. Insularity and dogmatism lose ground to openness and inclusion.

Open societies tend to become more tolerant—and not just towards their neighbors. Minor criminal offenses lead to more public outcry when punished. Since everyone does them, and everyone knows that everyone else does them, when one person is pinned, everyone voices a sense of unfair treatment. This causes civil unrest, which discourages further punishments. So in practice, this type of governance tends to lead to an increase in petty crime, as long as it remains petty. Repeat offenders or criminals who raise the stakes are still likely to be dealt with harshly as they exceed behavior that is considered justifiable.

There are some who argue that individuality suffers under universal surveillance. When everything about you is known, and you have little or no control over how your identity is presented to others, you become just another person in a mass of similar persons. With no way to define yourself, individuality is eroded. We all become everyman and everywoman, or so the argument goes. To the contrary, the amount of detail provided to everyone around us in a transparent society helps to show all of the subtle things that define each of us as a person. If identity is in the eye of the beholder, constant surveillance builds a stronger identity. Upon meeting a perfect stranger, it is trivial to pull up a large amount of data quickly, providing us with a passing familiarity with the person before we have even exchanged words. This smooths out personal interactions, making them easier, enabling us to bypass blockades from ignorance or awkwardness. It's not dissimilar from meeting someone that shares a mutual hobby; there's a degree of understanding between the two people that wouldn't exist in a vacuum.

Not all societies adapt to omnipresent surveillance so smoothly. In totalitarian habitats where surveillance tends to be weighted in the hands of the police state, a "thought crime" mentality can develop, where citizens actively avoid suspicious behaviors out of the assumption that somebody is watching, waiting to pin them with crimes uncommitted. Such thoroughly controlled environments breed hopelessness and despair—and occasionally resentment and resistance. At the opposite end, societies that embrace total openness sometimes develop unfortunate mindsets that consider privacy an affront. Those that refuse to be as open as those around them may suffer resentment and other negative feedback, possibly impacting their reputation scores. A similar effect is noticeable among hermits or people who are just inherently shy or withdrawn. The less they interact with the open culture around them, the more they are ostracized as an outsider, and their rep usually suffers as as a result.

SURVEILLANCE TECHNOLOGY

Source: Clandestine Operations 101: Remote Sensing and Sensors (Excerpted from *Sanitizing the Solar System: The Unofficial Firewall Sentinel Guide*) [Link]

Total Information Awareness (TIA) is a catchphrase often thrown about in surveillance circles. Let's be clear about something right up front: there is no *total information awareness*. You will never be able to access and monitor *all* the information that is present in an environment in a given timeframe, no matter what people may want you to believe—at least not in the heat of the moment, when it matters most. In most cases, there is simply too much data. Even with AIs, multitasking, and cognitive mods, dealing with the sheer volume of information available via surveillance networks is a major problem. Good spynet operators learn to filter out the chaff, to pay attention to the feeds that matter, to bounce between the data inputs most appropriate at any time in a dynamic situation, and to maximize their analysis by correlating data sets from different sensor feeds together. It's a tricky balancing act. Just as important is knowing what information you're missing—where are the gaps in your sensor network, what types of scans are unavailable, and what may have been disabled, tricked, or otherwise nullified.

No matter how good our surveillance technology is, it will never be perfect at detecting criminals, terrorists, or enemies—or in stopping events before they occur. Its use as a deterrent is limited. While sensors are beneficial in emergency response situations, even here they are vulnerable to interference and the impediments caused by general chaos. Where spynets really thrive, however, is in piecing together the data of what happened afterward. The omnipresent spimes and overlapping sensors in any habitat are a fantastic forensics tool, and the various lifelogs and personal sensor recordings of individuals often help piece any confusing elements together.

What this means for people in our line of work is that it is often impossible to avoid getting caught on record to some degree, despite your best counter-surveillance efforts. If you're careful and smart about it, however, you can avoid getting tripped up before an op is complete. The real challenge then is bugging out and getting clear before the trail you've left can

be used to track you down. The best operatives learn to minimize their trails as much as possible, do what they can to confuse and mislead follow-up investigations, and get out quickly, cutting all ties to the op and any IDs used.

It also means that sentinels need to learn to use spynets to the best of their capabilities. When monitoring or pursuing a target, knowing the tools you have at your disposal and the tricks for using them effectively can make the difference between a successful op and a slaughter.

Sensor Network Advantages & Limitations

One of the largest advantages to modern surveillance systems is remote sensing—the ability to capture information on a target, whether an object, area, or phenomenon, in real-time without needing to be in physical or intimate contact. The capabilities of some sensors to measure and record across long distances (from a few meters away to watching from orbit or across thousands of kilometers of space) and/or through barriers means that targets are often unaware that they are being monitored. Combined with miniaturization and wireless mesh capabilities, many sensors are small enough to avoid detection and the surveillance operators can be far away. When a closer look or actual physical contact is necessary, the use of near-invisible nanoswarms or microbots enables a spynet to unobtrusively acquire the data it needs. While most people assume they are under a certain degree of surveillance in urban areas, the actual extent to which they are being watched is easy to disguise. Likewise, the ubiquity of sensors and spimes means that even if a particular spynet falls short of its needs, there may well be public or private sensor systems the surveillance operator can access for their monitoring requirements.

Despite the integration of sensors into nearly everything, from highly sophisticated spimes to nanobots, morph implants, and other smart objects, a device's sensitivity, resolution, and precision can still be limiting factors. Different sensors are simply going to have differences in range and resolution depending on the magnitude of the target (astronomical, transhuman scale, or cellular to atomic size) and their own dimensions. It is important to have the right tool for the surveillance job.

While breakthroughs in computing, energy self-sustenance, and nano-engineering have produced sensors able to resolve signals several orders of magnitude higher than those built in the decades before the Fall, the ubiquitous distribution, networking, and correlation of collected information remains the true boon to modern panopticon technology. Sensors or the operators using them can easily verify or enhance their own measured data with information supplied by other meshed sensors in measurement range. Since sensor data can also be easily stored, shared, and archived, it is a simple matter to cross-reference the "historic" data of other sensors in the same state as the one used as a reference. This is a common procedure to validate results and reduce background noise in an area scan.

The interpretation of sensor input is another potential liability with some surveillance devices. Since the actual users rarely possess the scientific understanding to analyze a sensor result from an advanced device properly (for instance, the virtual model of a full morph body scan involving terahertz exterior and high-resolution X-ray/magnetic resonance tomography interior scans), interpretation is instead carried out by specialized AIs. These automated programs correlate sensor readings with databases of reference scans to provide an analysis. The drawback is that this system tends to give simplified answers to what are otherwise very complex processes. There is often room for interpretation in the results provided, given the limitations of AI skill and knowledge programming. To reflect this, many scanner systems provide a confidence level rating with each result. An infrared lie detection scanner, for example, rarely admits 100% certainty that someone is lying. To counteract this uncertainty, many modern scanner systems incorporate multiple different sensor types and use analytical techniques to minimize false positives and negatives.

Sensor Types

To make the most of a spynet, you want to know the capabilities and limitations of the sensors at your disposal. Some sensors are ideal for certain situations and terrible at others; they may require fixed positions and be useless for mobile operations, or they may work best when integrated with other sensors. Here's a breakdown of the state of sensor technologies.

The Visual Spectrum

Cameras recording the standard visual part of the light spectrum remain a mainstay of surveillance systems. These are ubiquitous, incorporated into common spimes, public infrastructure, and other "everyware" devices. Thanks to advances with lens design and digital resolution techniques, even tiny cameras can produce highly detailed three-dimensional images and recordings. The camera lenses present in many spimes and devices are so small and unobtrusive as to be quite difficult to spot, though automated lens detection systems can locate them by laser reflection. Flat camera systems use multiple micro lenses networked together, with a central processor combining the inputs into a single high-resolution image. These allow flat surfaces to be covered in small imagers that are even harder to detect visually (but still apparent to lens spotter systems).

When combined with augmented reality, networked cameras can provide visual feeds on objects the viewer cannot physically see through. This is especially useful for traffic systems and navigation, where drivers and pilots can use the views from linked cameras to see what is going on beyond barriers and obstructions.

QUANTUM DOT CAMERA-DISPLAYS

The cutting edge of camera systems are quantum dot camera-displays (QDCDs). These fullerene arrays of quantum dots have the capability to both detect and emit light, simultaneously acting as high-resolution camera and display. This enables the creation of displays that also watch the viewer. The real value of QDCDs is that they can be applied as a paint-like film on just about any surface. This means that any wall, object, or device can be transformed into a combination sensor systems and visual display. Because QDCDs do not use traditional lenses, they are invisible to lens-spotting devices. QDCDs can also detect the infrared and ultraviolet wavelengths. ■

Higher-end camera systems can be equipped with quantum ghost imaging technology, enabling clear pictures to be taken through visually obstructive conditions such as clouds, smoke, fog, dust, and haze. These systems are common in military, gatecrashing, and search and rescue operations, enabling visual sensors to get a clear image of a situation despite explosions, heavy weather, and other impeding factors.

One common tool for area surveillance is super-wide camera systems. Aerial and even orbital drones are often equipped with these sensors, providing continual coverage of an area by hovering or regular overhead fly-bys. A single super-wide camera can provide detail on an area up to 300 square kilometers in size down to 0.1 meter resolution. These cameras are also common in the upper infrastructure of dome habitats and the axis points of cylindrical and spherical habitats.

A drawback to visual camera systems is that they are sometimes vulnerable to high-resolution holographic displays, especially at a distance. These sorts of hyper-real illusions are easy to spot with combined systems, however, as infrared or other scans will likely show the hologram as false. On the positive side, camera recordings can be slowed down to analyze situations at a slower speed, revealing information that is often missed at real-time speeds. This is especially useful for measuring micro-expressions and other visual tells indicative of deception or emotional states.

THE HIGH ELECTROMAGNETIC SPECTRUM

Many common camera systems are also capable of detecting infrared wavelengths in addition to the standard visual spectrum. This allows the cameras to function in low-light/night-vision conditions. Unlike

the monochromatic displays of old infrared systems, modern cameras see infrared wavelengths in color, much like standard vision with appropriate lighting.

Infrared thermal-imaging is useful for detecting heat sources, including the residual heat traces left behind by someone recently sitting on something, walking through an area, or handling an object. The greater the temperature difference between the heat-emitting source and the environment, the easier these heat traces are to detect. Thermal imaging of the blood flow in the face, particularly around the corners of the eyes, is a component of lie-detection systems. Thermal infrared is also helpful when combined with standard visual systems, as it can see past fog, smoke, and light particles that might obstruct standard visual wavelengths.

Terahertz scanners are less common, but still see widespread use, especially at security checkpoints. Terahertz imagers have the advantage of being able to see through walls, clothing, and other material, though not as effectively as radar or x-ray/gamma-ray frequencies. Unlike these other wavelengths, terahertz sensors tend to be smaller and more portable. Though they function better as active systems (emitting t-rays), they can function as passive receivers at close ranges. For this reason, passive terahertz scanners are favored as a form of undetectable portal scanner. The drawback is that terahertz scanners will not detect contraband implanted within biological bodies, as t-rays do not penetrate skin.

Active radar systems are commonly used for air/space/ground vehicle traffic and habitat/ship defense systems, and are sometimes deployed to detect small surveillance drones. They are less common in habitat and personal surveillance systems, due to their poor resolution and decreased effectiveness against less-reflective biological targets. Because the wavelengths they operate at are large, radar systems are portable but cannot be miniaturized to even hand-held sizes. Radar sensors are thus visually obvious and also detectable as actively emitting systems.

The deployment of quantum radar has increased the effectiveness of radar systems, particularly in battlefield or cluttered conditions. Using entangled beams to take advantage of the low attenuation and high range associated with a long wavelength and the high resolution associated with a short wavelength, quantum radar does not have to compromise between range and resolution. Quantum radar is also more effective for image processing/recognition and detecting concealed targets.

Inside urban areas and habitats, security teams sometimes deploy a trick known as variance-based radio tomographic imaging, particularly when they want to see inside an area without using an active system like radar that might trip a passive sensor and alert the target they are being scanned. This trick takes advantage of the wireless nodes that are ubiquitous throughout a given area. By measuring the transmission and reception of the common radio signals on opposing sides of the target area, variations in the waves can be detected that indicate someone or something moving in the observed area. This allows observers to map the positions of any movement inside, thus detecting what room someone might be in or if anyone is even in the area at all.

The Low Electromagnetic Spectrum

Similar to infrared, many common camera systems are capable of recording the ultraviolet spectrum as well. Aside from people and designers who happen to like decorating their selves, clothing, or designs with ultraviolet artistry, the main use for UV sensors is to detect security tagging. Some security systems, particularly anti-theft set-ups, are designed to mark a target with dye that is only visible in ultraviolet, making them easy to track and spot. This is a common trick also used by physical surveillance teams that are tailing a target—marking them with UV paint to make them easy to spot in a crowd or to catch a particular pattern via image recognition in a habitat-wide scan.

Active x-ray and gamma-ray sensors are less common, except at security checkpoints. While useful in portal systems to detect weapons, implants, and contraband, portable versions of these devices tend to be restricted due to potential health risks from radiation exposure. Nevertheless, security bots are sometimes equipped with backscatter x-ray imaging systems and set to patrol or monitor key areas of habitats, randomly imaging passers-by. Radiation sensors are also a common feature in habitats, both to prevent transportation of weapons of mass destruction and to verify the habitat's integrity at keeping out solar radiation and cosmic rays.

Audio Sensors

Microphones that capture audio frequencies in standard human hearing ranges are almost as ubiquitous as cameras—in fact, the two are often combined. Audio input can be checked against online databases, instantly identifying the source of a sound. Multiple microphones can be used to triangulate the origins of a sound. If gunfire or yells for help are heard, the source location can be pinpointed for further investigation. More sophisticated audio sensors allow conversations to be isolated out of a crowd or similar noisy environment. Similarly, laser microphones can detect audio and conversations taking place inside a room by picking up the vibrations of the sounds in glass or aerogel.

One drawback to audio surveillance is that it is easy to mislead. It is quite difficult to distinguish between a real sound and one previously recorded and played back, unless some other sensor system is able to record whatever created the sound as it did so. Voice analysis is also not perfect for identifying

individuals, as people do not have unique voiceprints (especially synthmorphs). Voice analysis is, however, used to measure stress and response spaces in deception scanners.

Ultrasonic audio sensors are rarely used for surveillance purposes, except when incorporated in motion detection systems. Infrasonic audio pickups see more widespread use, particularly in monitoring the shell of habitats and ships. Audiosensing fiberoptic cables are often seeded the length of a security perimeter. These are capable of detecting the seismic signature of breaches in a wall or other barrier, and can also identify the acoustic signature of footfalls or moving vehicles a short range away.

Chem Sniffers

Modern chemical analyzers rely on a mixture of spectroscopic and direct compound recognition methods, including ones biomimicked from human and animal olfactory and taste organs, to identify chemical components. The primary use for these sensors is in portal security systems to detect firearms and explosives, though this use is declining given the number of weapons and threats available that these sniffers will not detect.

More sophisticated nanotech chemical detection systems are placed throughout the ventilation systems of habitats and ships. These monitor air flow and quality, triggering alerts when sufficient quantities of smoke or other toxins or pollutants are detected or if the air composition strays from breathable levels or becomes too oxygen-rich (creating a potential fire or explosion hazard).

Some habitats have taken to using genetically engineered plants with special proteins that react in the presence of certain chemical concentrations. Around security checkpoints, these plants will turn white when they detect traces of certain explosives in the air. Others are designed to transform bright red if the atmosphere becomes dangerous (too much carbon monoxide or oxygen).

Some chemical sensors are specifically designed to sniff for alarm pheromones emitted by biomorphs. These chemical triggers are produced in sweat when a person is scared or worried—say a smuggler who fears being discovered or a terrorist on their way to commit mass murder. These primarily appear at customs checkpoints and the portals of high-security installations.

Biometric Sensors

Biometric sensors measure the unique characteristics inherent to individual biomorphs such as fingerprints, palmprints, retina patterns, and DNA, among others. These systems have fallen out of style given that they are only useful in identifying biomorphs and not synthmorphs or the ego within the morph. Though also once common as an authorization method in security systems, this has been abandoned due to the ease of acquiring biosculpting and genetic mods that could circumvent such measures.

The biometrics used today tend to be systems that can scan and recognize identifying features non-invasively from a distance. These include laser retina scanners, portal-based x-ray skeletal scanners, personal body odor sniffers, and cameras with facial recognition software. Some security installations and customs checkpoints still deploy entryway puffers that blow skin flakes and loose hair into an analyzer for DNA testing. Nanoswarms are also sometimes used for this purpose.

One biometric system still sees common use: gait analysis. Gait analysis has been found helpful in identifying people even after they have sleeved into synthetic morphs, assuming it is a bipedal walker, like most cases and synths, and not using some other propulsion method. Gait scanners can even be deployed by overhead drones or orbital spysats, as gait can be measured and recognized based on the shadow a person casts.

Smart Dust and Scout Nanoswarms

Nanobot scanning systems are more common than many people realize. Their effective invisibility, combined with their ability to "touch" and sample the target directly yet non-invasively, make them an ideal scanning system. They typically are set to linger in a confined space (programmed boundaries) where they are replenished by a hive and discreetly analyze anything that passes through. They excel at acquiring DNA samples, identifying morph types, and investigating chemical residues.

Smart dust nanoswarms can also be instructed to catch a ride on passers-by, thus acting as a "bug" on the person or thing's activities for the duration of its existence. These spy swarms have the ability to video, audio record, and even monitor radio and mesh activity. Some are set to transmit a steady stream of data back to their source, but the more discreet versions maintain radio silence and only transmit bursts of information at staggered intervals, to better avoid detection and interception.

Mesh Surveillance

Anyone with mesh inserts or an ecto—which is essentially everyone—leaves a data trail everywhere they go, tying their mesh presence to their physical activities. Most people do not obfuscate this activity, making it a trivial measure to track them online. Those who stealth their signals and/or engage their privacy modes may still be tracked, albeit with more difficulty. In some habitats, stealth/privacy modes are illegal or a sign of suspicion; users who engage them may end up bringing more attention to themselves by doing so.

Social networks add an extra dimension to this data. Not only can you track people quite easily, you can map out their relationships with others and

PSI SURVEILLANCE

It's worth noting that while some asyncs are known to have the ability to detect other life forms, read thoughts, and so on, there is no known (or at least widespread) method of employing these on a large scale. The mental effort expended to exercise these sleights is usually too draining to engage in on a mass basis. They are, however, useful for specific targeted surveillance instances.

Likewise, there is no known way to identify an async in a crowd or to detect the use of async abilities in an area. This allows asyncs to operate largely unhindered and undetected, should their identity and nature remain unknown. The use of psi jamming devices can of course impair their abilities, but only over limited areas. ■

gather intelligence on whole groups of linked people. The reputation award and strike interactions between people are also illuminating, linking people together at particular junctions and giving a sense of the progression of their relationship.

Some habitats and voyeurs make a habit out of intercepting and sniffing wireless transmissions. Security services may do this as preventive measure, scanning the intercepted traffic for keywords that might indicate criminal or suspicious activity. Voyeurs do it to get a taste of others' lives, snooping on their affairs from afar. These interception measures may be countered with the use of VPNs or encryption, but in some jurisdictions these defenses are illegal or restricted.

Many people make their lifelogs and X-casts available to the public mesh, providing a real-time stream of data directly from their own sensorium or surroundings. These feeds are often monitored by others, so that if anything should happen to the person, others would likely know about it instantly.

OTHER SURVEILLANCE SYSTEMS

There are many other sensors used to monitor the activities in a given place. Each of these is more limited, but still sees occasional or specialized usage.

Enviro Scanners: All habitats, from the lowliest tin cans to the largest O'Neill cylinders, are littered with spimes designed to collect environmental information such as air pressure, gravity, oxygen and

carbon dioxide levels, and temperature. Plumbing systems measure water quality and recycling efficiency. Infrasound receivers, pressure and strain gauges, radiation detectors, dynamic photoelasticity scanners, gas and other olfactory sniffers are used to oversee the integrity of the habitats' interior and exterior. Space habitat exterior sensors monitor the solar weather and scan for approaching objects (micrometeorites, debris, vessels) through the entire EM spectrum. Planetary habitat exterior sensors and satellite systems are meshed together to assess weather phenomena (storms, electromagnetic disturbances, seismic activity, rain) that may pose a threat. These safety and early warning systems are designed to trigger alerts if they start to degrade and fail beyond the capacity of their maintenance bot, repair crews, or self-repair nanoswarms.

Lidar Systems: Lidar systems are also nearly universal in the major public areas of habitats, as well as high-security areas. Lidar is particularly useful for developing real-time, comprehensive, three-dimensional maps of an area and noting any changes that occur to the positions of people and objects in that area over time. Lidar is also incorporated into stress and deception scanners, as it can remotely detect respiration and pulse rate.

Metal Detectors: An old and dated standby of security systems, metal detectors are still useful for detecting contraband and implants at checkpoints. Due to limited range, these are usually deployed as portal-based systems or hand-held wands to run over a person's body. Though they are useless against non-metallic objects/implants, they can provide data on the mass and type of metal when they get readings.

Nanodetectors: Common in high-security areas, these scanners suck in air to detect the presence of nanobots. These are especially prevalent at custom and ship entrance points, to deter against TITAN nanoswarm remnants from the Fall.

Organic Sensors: A few sensor systems are grown rather than constructed. These modified versions of biological sensory organs are upsetting to some (particularly bioconservatives), but they are as effective as a biomorph's senses—sometimes more so, when used en masse. These organs are linked by biological nerve strands that extend thousands of meters through the walls to a cyberbrain interface, literally servings as a habitat's eyes and ears. Organic sensors are typically only found in biohabitats. They require a biological system of nutrient feeding, sustenance, and waste removal.

Pressure Sensors: Built into the flooring of entrances and junctions in many habitats (those with gravity at least), pressure sensors are primarily used to track the passage of heavier synthetic morphs, bots, and vehicles or to keep a simple head count on how many people are in a particular area. More sensitive versions can detect the footfall patterns of specific morphs.

Proximity Sensors: Portal-based proximity sensors detect the electrical fields of those passing through (even that produced by biological skin). These do little to identify an individual, they simply mark the passage of a person or machine.

DATA CORRELATION

The vast amounts of data accumulated on individuals and their activities online can lead to quite interesting results when correlated. Seemingly unrelated and non-interesting pieces of data can piece together into amazing revelations. The value of cross-indexing data is not just in understanding people more thoroughly—it also brings to light new relationships and activity that might otherwise have gone undetected. Additionally, many sensor systems collect ancillary data outside of their prime purpose, which often gets archived regardless of relevance. The x-ray scan of a person at a security terminal

TARGET DATA

- Tell me that have something useful on our target. With all that data we scored, there had to be something.
- Indeed. First, you'll be interested to note that our traffic analysis on his mesh calls suggests a 93% probability that he's been contacted by the Cartel. He encrypts his links, of course, but the duration and timing make it likely.
- Perfect. That means he'll have the goods soon?
- That seems to be SOP. Our profiling of his affairs suggests that he'll receive the shipment today.
- Ok, so we need to lure him out fast. We'll need a rundown on his likely movement over the next 48 hours and a plan to catch him unaware.
- Already on it. According to the profile we built, there's an 88% chance he'll be at his regular nightclub haunt tonight. We've mapped the place, pinpointed his usual seating, and marked out the best window of opportunity given his habitual timeframes. He tends to booze up (66%) and pick up strangers (23%).
- Sounds like a perfect opening. What's his taste?
- For booze, he's all whiskey. For pickups, he seemed bi on the surface, but we took a deeper look and found that all of his previous partners whom we could ID were male egos. So, men, no matter the morph. We've built a profile of personality traits and looks he seems to favor.
- Excellent. Get that to our operative and call a meet in 2 hours.

may have found no trace of contraband, but it may also have recorded a potential health issue that was outside the boundaries of its programming and so remained unreported. Later analysis of the x-ray scan in conjunction with other medical data could turn up unexpected results.

Probability Mapping

Probability mapping is the analysis of patterns of activity over time in order to model and predict likely future events. Transhumans are creatures of routine. Many people take the same routes to work at the same times every day or go to the same few restaurants or clubs with periodic frequency. Traffic through an area swells and thins at predictable rates. Criminal activity tends to focus around specific areas at specific periods. When you take the vast wealth of data available on the people in a particular habitat over years and feed it all into a quantum computer and group of AIs with potent pattern recognition algorithms, these systems can build models that are eerily accurate even with a nigh-infinite number of variables. Police units in the large Martian cities use these systems to identify hot spots and direct police units there to deter expected crime. Travelers access traffic AIs to determine the route most likely to have the least traffic. Anyone looking to monitor someone else's activity can use similar AIs and input to build a substantial predictive itinerary for that person's daily routines.

Behavioral Psych

Probability surveillance easily crosses over into the land of behavioral psychology and profiling. While standard data surveillance tells a great deal about who did what and where they did it, behavioral tracking takes the same concepts to a whole different level. A surveyor well-versed in the intricacies of psychology sees the tells of data and forms a complete understanding of the way a person thinks and operates. The products we buy, the information we access online, the people with whom we associate, the places we frequent—these are just the beginning of the story. In a cafe, the table one chooses to sit at tells something of their personality. If one walks quickly to the cafe, but slowly to work, it says something else. Bed times, air conditioning levels, games played, these things are signals to a behavioral tracker. When combined with input from biolidar systems, stress scanners, analysis of our personal chemistry, and recordings of how we interact in different situations in our lives, a much deeper profile can be built. Lifelogs and X-casts are a virtual gold mine for these types of analyses, especially when measured over long periods of time. Some scientists swear by the discipline, advocating the universal assignment of numerous profilers to keep detailed case files on every transhuman in their habitats.

Precog Systems

The unholy territory where probability and behavioral surveillance combine is colloquially known as "precog." Precog systems are used to predict a person's actions based on their sociocultural behavior, ground state abnormalities (people tend to change their standard MOs before committing a crime), interaction profile, mesh activity, and numerous other factors. Though far from perfect, these systems are sometimes accurate in gauging the likelihood of anti-social or criminal behavior. These predictive systems are not only applied against individuals; precog analyses are also used to gauge the potential momentum and activity of mass groups, particularly in situations of unrest or civil disturbance.

SOLARCHIVE SEARCH: ISSUES WITH PRECOG SYSTEM IMPLEMENTATION

Though "precog" analysis systems have had a marginally effective success rate in predicting crimes when implemented under real conditions, their use has raised a number of social and legal issues. While the primary function of precog systems is to predict and prevent crimes before they occur, legal action against the potential criminal before the activity has been initiated rests on very thin and dubious moral authority. Most jurisdictions do not condone the arrest and conviction of people for crimes they have not yet committed, no matter how trusted the precog analysis. Some political systems advocate altering the variables of the situation to produce a different, more acceptable outcome. This can include issuing warnings, offering free counsel, or taking the suspect into "protective" custody for a temporary period. Some go so far as to enforce psychosurgery or restrictive limitations such as home confinement, restricted travel, or mandatory accompaniment by a robotic guardian. Many see these measures as simply giving the potential criminal warning that they are being watched, encouraging them to go about their crime in a more clandestine manner or switching to other criminal behavior. Instead, these jurisdictions pursue policies of aggressive surveillance and containment, monitoring the suspect and intervening before they can act, but only once they have crossed a legal threshold for culpability. The most restrictive authorities simply treat precog results as fait accompli, and move to capture and punish the potential offender as if they had committed the crime they were predicted to commit in the future.

COUNTERSURVEILLANCE

Source: Clandestine Operations 102: Becoming a Ghost (Excerpted from *Sanitizing the Solar System: The Unofficial Firewall Sentinel Guide*) [Link]

Now that you've learned how sensor systems work and what their capabilities are, it's time to take a look at how to avoid, bypass, fool, and otherwise subvert these systems for your own ends.

PRIVACY FOR THE WICKED

One thing that people in our line of work quickly realize is that it is not only important to practice operational security when on a mission, it's a good idea to keep a low profile as a matter of course in your daily life. The less info there is on you out there, the less can be used against you. If you practice the bare minimum of enhanced privacy precautions on a daily basis, it makes it that much easier to keep the routine going when it counts. One mistake is all it takes to ruin an op.

To that end, every sentinel should be in the habit of operating in mesh privacy mode. This might make some aspects of your life inconvenient, when friends, families, and services cannot quite as easily locate you on demand, but it helps you maintain a low profile. If you must lifelog, don't share it publicly—archive it in encrypted storage, and back it up. Forget about X-casting, you may as well ask Ozma to open an office inside your brain. Likewise, stealth your signals, fake your mesh ID, and use anonymous accounts, VPNs, and encryption. You never know when someone may take a closer interest in your affairs, and the worst time to find out that someone has been sniffing your comms for weeks is right in the middle of an op.

The drawback to covering your tracks like this on a daily basis is that it sometimes makes you look like, well, like you're covering your tracks. People who engage all of their privacy functions sometimes stand out in a transparent society. It may make people suspicious, thinking that you're up to something. If you're only encrypting your communications with certain people, it sometimes makes it look even worse, like you're collaborating—and it also pinpoints who you're in cahoots with. So if you're going to push ahead with enhanced privacy, do it across the board, in all aspects of your life. Create a cover for yourself while you're at it. If you build up a reputation as one of those old-fashioned "privacy nuts," people are less inclined to think you're up to no good—they'll just think you're weird. If you have a good reason for the enhanced privacy—such as freelancing for a client on a top secret hypercorp project—even better. Then you have justification for protecting your affairs.

Sometimes a better option is to live the double life. Maintain a public presence, keep up a good transparent front, and very carefully practice your private biz in complete stealth mode on the side. This takes care and practice. Disposable ectos are essential to this sort of lifestyle. This also means having contingency plans in place for new communication channels when your secret lines and routines get accidentally or intentionally compromised.

If you need to spend credit without linking it to your ID, crypto-cred is your best friend. Crypto-cred services are accessible around the solar system, making it easy and convenient to make completely anonymous purchases. Crypto-cred is growing increasingly popular in the inner system; many hypercorps take advantage of these services to make it harder for their competitors to keep tabs on them.

PHYSICAL PRIVACY

All of the methods above are useful for concealing your mesh activities, but they do little to protect you from physical surveillance. Maintaining privacy in public is quite challenging in an environment of ubiquitous surveillance. There are some options, however.

In habitats where such things are acceptable and legal, personal privacy shrouds are an occasional sight. These smart fabric garments effectively block most sensors, preventing the person inside from being identified. Shrouds are growing increasingly popular in socialite and celebrity circles, as they foil the efforts of stalkers and voyeurs.

If you're seeking a bit of in-person conversational privacy, many establishments offer private rooms that are scoured of listening devices and other sensors. Many private residences, business offices, and secure installations have "cleaning systems" at their entranceways that scour anyone entering of electronic snooping devices, including bug zappers to disable nanoswarms, specks, and similar hard-to-spot spyware. Otherwise a set of access jacks and a fiberoptic cable are ideal, as external sensors can't monitor mental communications (barring a cyberbrain hack). Line-of-sight laser communication systems are also good for countering eavesdropping, as tight beams are difficult to intercept, especially when used at short distances.

It is important that mesh privacy and physical privacy be practiced together. Using a fake mesh ID is pointless if you are running around with the same morph that your real name and mesh ID are linked to; eventually someone is going to correlate surveillance footage and mesh activity and link your face to the fake mesh ID. If you're just seeking temporary privacy, this is not a big deal, but long-term data forensics is likely to uncover such poor practices.

LIVING THE LIE

Fake identities are standard fare in Firewall operations. Proxies will often provide cover identities for sentinels, but you are encouraged to have your own on hand. You never know when things will go awry

TRND ARCHIVES: GHABIL'S SHROUD TEASES THE AUDIENCE

Originally Published: 7 AF, Eskell Fashion

The bright lights weren't bright enough to penetrate the inspiration at the heart of Khalim Ghabil's new line launch for his high-fashion shroud. Before the show opened, guests were given special masks of smart fabric that blocked sight and hearing and all local spimes were shut down (as has become de rigeur for shows this year, to embargo news of hot fashion designs before the official mesh release is distributed). Ghabil went the extra mile and managed to invoke some serious jamming, cutting the entire audience off from the mesh. After bumping around in the dark for what felt like an eternity, the masks all became translucent and we were in the midst of the show. A dozen models slowly circulated through the crowd in enveloping fabric wraps, each in a different neutral. No visible openings and no collisions gave away the integrated optics, but that was all you could tell. As they moved, sections stiffened or folded in erratically so even their gait was obscured. There was no music, only occasional utterances of "anonymity, privacy, relief" and "shelter, sanctity, safety" to punctuate the murmurs of the crowd.

The show eventually faded away, with no big reveal, and the man himself was nowhere to be seen (though rumor has it he was in one of the shrouds). There is no consensus yet on whether this anonymizing fashion statement is genius or the troubled designer's last scratch at fame. Only time will tell if the shroud becomes widely acceptable in public circles. The bravado of the statement, the reconnection of fashion to identity, and the technical achievement of this event won me over. I can't wait to see what KG has hidden for us. ■

or when old enemies may catch up to you. It is best to have multiple IDs at your disposal so you can burn and dispose of them as needed.

Purchasing Fake IDs

A good fake ID is more than just your brainprint with a new digital code stamped to it or a new nanotat ID for your morph. Though bare-bones fake IDs are cheap, they arouse suspicion by the fact that there is no history or data trail attached to them (though this can often be explained away as being a newly instantiated infugee). The best fake IDs are completely fabricated personas with detailed histories spread across multiple archives and habitats. They also come with pregenerated credit accounts and reputation scores in various social networks, so it doesn't seem as if your identity suddenly sprang from nowhere just a few days ago. Criminal cartels that specialize in fake IDs can be very thorough with these backgrounds. They use multiple methods, from hiring people (or employing forks and AIs) to establish the transactions and data trails for multiple IDs over years to gaining backdoor entrances into linked databases and using these to insert new identities and carefully proliferate them to other archives. They take full advantage of the fact that habitats and polities do not collaborate on ID checking; many IDs in fact originate from shady habitats like New Sicily that seem to have an inordinate number of legitimate new citizens spring from nowhere on a daily basis. Rep scores are carefully established over time via sophisticated puppetnets, with thousands of fake IDs serving as an echo chamber with each other for the establishment of credible rep histories. The anti-counterfeiting algorithms employed by social networks prevent these fake rep scores from being elevated too high, but they do provide a starting point so that your new persona isn't a complete unknown without clout.

A New Life From Scratch

After the Fall, countless infugees survived only to be locked away in cold storage, isolated to simulspace prisons, or enslaved in indentured data farms. Even a decade after the Fall, new infugees are being revitalized and re-instanced in new morphs. Many of these have no data trail or historical records attached to them, as this information was lost during the Fall. This is the perfect opportunity for anyone seeking a fresh start. Dump your morph, clean up your data signature, darkcast to a new location, and introduce yourself as a refugee from the Fall seeking asylum and a new life. Unless you make resourceful enemies, it's not likely the deception will even be called into question, let alone researched. The trick is in picking a habitat that is open and friendly to new infugees and asks few questions. Though this is easy to find in autonomist space, there are inner system stations that are just as receptive.

Earning a new ID this way requires some finesse. Infugees rarely have resources at their disposal, so for your cover story to be consistent you may have to spend some time as an infomorph, perhaps taking on minor jobs to earn credit or reputation. There are ways around this—some infugees brought credit

accounts with them or are restored to find inheritances waiting for them, tucked away in the mesh of other habitats by relatives that died during the Fall. With some careful pre-planning, a backstory like this can be established. Otherwise, this method can be time-consuming to pull off successfully.

Trading IDs

Alternately, some infugees are more than willing to trade their backhistories and identities with someone else if the price is right. If your rep is low and you've made some enemies over the years, the prospect of surrendering your established identity may not seem so bad given the credit you would earn. Many infugees have lost everything—their friends, their relatives, their lovers, their homes—and have no qualms about surrendering their old identities and starting anew.

Reassigning IDs in this manner is not difficult, especially with the right underworld connections. In autonomist areas, it is often quite easy, assuming both parties consent to the switch and all of its ramifications. This option is a good one for sentinels who have real IDs—or even fake ones—that are essentially compromised. It is, of course, not recommended in situations where the traded ID may cause severe complications for the new owner. If you happen to have racked up some arrest warrants in the Morningstar Constellation, however, that is likely to be unimportant to an infugee who plans a new future in the Uranian autonomist colonies or, better yet, seeks to try their hand at gatecrashing and extrasolar colony life.

Stealing an ID

Stealing identities is always an option, especially if you only plan to use the identity for a short period and the original owner of that ID is far enough away and low profile enough to be unlikely to catch on soon. A sifter who has spent the past decade hammering rocks on Mercury is unlikely to notice that you're using their ID to maneuver in the tunnels of Extropia without too much attention—at least until you start triggering lots of flags or otherwise drawing attention to yourself. Even if you rack up some arrest warrants, legal torts, fines, and reputation strikes, you are unlikely to do lasting damage to that fine sifter's life as they should be able to easily and quickly deny responsibility—though you may cause that poor soul some unfortunate stress and inconveniences.

Various criminal networks excel at stealing ID information and selling it through black market channels, particularly the ID Crew. Purchasing a stolen and disposable ID of this type is often the best option for quick and dirty operations.

Fake ID Complications

Operating under a fake ID is not always as simple as it seems. The drawback to using a fake ID is that you cannot rely on your own carefully built-up reputation and network of friends and colleagues. It can sometimes be tempting to take advantage of two identities at the same time, so that you can operate with some pseudonymity and still fall back on your rep, but you run the risk of linking the fake ID to your real ID in these situations. One mistake and the carefully constructed persona you've been operating will be useless—possibly endangering your real life ID in the process.

Fake IDs are also vulnerable to brainprint matching. If you happened to rack up a slew of heavy criminal charges on your last visit to Elysium, then even if you return under a fake ID, you may be nabbed. This is

because your brainprint will still be the same, even if it is attached to a new ID. Brainprints are not always checked against similar prints in the system, but security and customs often doublecheck new arrivals against the brainprints of their most wanted or most recent criminal elements, exactly to foil this kind of thing. Luckily, brainprints change over time, so this becomes less and less of an issue, but a match still might be close enough to raise flags. Matching brainprints are not always uncommon given the proliferation of forks, but this is not necessarily an escape clause unless the fork happened to predate the criminal activity.

Some stolen and traded IDs run afoul of synchronicity. You may be in the middle of an op when you suddenly run across an old friend of your ID's previous owner, forcing you to scramble for a cover story without triggering suspicion. Though rare, these sorts of situations have a habit of popping up at the most inconvenient times.

Awareness

When it comes to countering physical surveillance, the first step is to be aware of it. It can be incredibly helpful to know exactly what type of sensor coverage is present in a particular area. An intersection that happens to only be covered by a few visual-spectrum cameras and microphones, for example, is an ideal place to try and stage a holographic illusion that would be foiled if other sensors are present.

The easiest way to catalog what sensors are at work is to simply ping the local public mesh. Most sensors, including private ones, will acknowledge their presence online. This will not list out any sensors that are operating in private mesh mode, but you can sometimes find these by searching for stealthed radio signals. If your primary concern is accidental viewing by a publicam voyeur, then knowing where those cameras are placed is half your battle.

Active sensor systems are easy to detect because they are transmitting signals. Radar, microwave, lidar, x-ray, and gamma-ray emitters are trivial to detect with the appropriate receiver. Nanodetectors will let you know about any lingering spy swarms. Passive cameras can be detected by lens-spotting systems that use lasers to illuminate an area and detect the reflections from the lens. If you really want to know what's in a room, drop some smart dust and pick up the readings later. Nanoswarms are one of the most effective methods of cataloging all of the sensors in an area.

Blind Spots

How do you move around in an environment of total surveillance without being seen? You find the blind spots in coverage—or better yet, make your own.

The process of ghosting—moving between gaps in the sensor coverage—requires a lot of advance preparation. If you know the route you need to take, you can map it out in advance, using the tricks described above to pinpoint all of the spimes and scanners. You want to do this without being obvious, so it may take several passes or a combined effort by a team. Alternatively, you can seek out blank spots in the surveillance coverage and look for ways to link them together.

Some areas are quite intentionally kept off the grid. Criminal outfits that don't like people poking into their business quite often sterilize a surveillance-free zone around their holdings. Groups like Datacide or the Decepticons go out of their way to create blank spots in a habitat's watchful eye. Some of these can be found online, if you know where to look or who to ask. Others are sold for a price. Clearing a path of sensors is high-paying biz for both tech-savvy crime cartels and private investigators or freelance security specialists. Some privacy-friendly establishments have secret and scanner-free entrances and exits, made available to favored clients at an affordable rate.

When all else fails, you can create your own blind spots. This involves dropping a saboteur nanoswarm on an area with specific instructions to target surveillance devices. Bughunter bots serve the same purpose. Used together, this is an effective way to clear a zone of unwanted spyware. The main thing to remember is that blind spots don't remain blind for long. Repair systems and bots will revive or replace disabled publicams and other spimes. New sensors will be seeded in an area by people who notice the lack of coverage. Your clear zone will only remain safe for a short window of time, so take advantage of it while it lasts.

The trick to using blind spots is that your entrance and exit from the sensor-free zone must somehow be disguised. Otherwise you can still be tracked as you enter and leave the hole in coverage. This means that you must employ deception to lose your trail or otherwise trick the cameras before you take advantage of the blind spot.

If you have the resources, and the particular sensors you need to blind are privately owned, sometimes it is a simple solution to buy them out. If you own the scanners, you control when they are on and what they record, and it becomes much easier to fabricate recordings. This option generally only applies to private sensors in public areas, as few people are willing to relinquish ownership of the cameras in their own homes and offices.

Jamming and Blinding

Rather than destroying sensors, it is sometimes easier (and less incriminating) to temporarily jam or blind them. Radio jamming is only effective in scrambling radar, though it will disrupt any real-time feeds that any local devices are transmitting via the mesh. A similar mesh-jamming effect can be gained by launching a denial of service attack against all devices in a particular area or unleashing a batch of kaos AIs. Active sensors can sometimes be jammed or disrupted by tweaking one of the emitters in an area to generate so much background noise that it drowns out the other emitters.

Jamming mesh signals will not stop a camera from recording, but blinding it with a dazzler laser system will. Similarly, microphones can be drowned out with a white noise machine. If the sensor system you are worried about happens to be a person, that's where prisoner masks (for biomorphs) and disablers (for pods and synthmorphs) come in. Some morphs are even designed with countersurveillance in mind and so come equipped with sensor jamming and blinding modifications.

DECEPTION

When you can't disable or blind a sensor, your path is clear: fool it. There are many methods for fooling publicams and other scanner systems, though the best option will likely depend on the situation at hand and your specific needs.

The simplest and crudest tools for camera deception are chameleon and invisibility cloaks. While these are effective, simple disguises are often even easier—or trivial if you happen to possess false face nanoware and chameleon skin. Disguises also have the advantage of allowing you to change your looks and pass as other people, which is sometimes more important than simply disappearing. If you are hoping to avoid facial recognition scans, the application of makeup, nanotats, or skin designs in specific patterns is enough to foil the pattern recognition algorithms by breaking up outlines and identifying marker points. This is also where biomorph clones with common cookie-cutter looks come in handy. Some morph models are quite common in large habitats and individuals in these morphs can quite easily be mistaken for each other. A clever team can take advantage of this by all choosing identical common morphs, thus foiling attempts to ID individuals by facial recognition.

The ability to switch morphs is a boon to sensor evasion methods, particularly with pods and synthmorphs, as an ego can evacuate from a cyberbrain quite quickly. Two synths, for example, seemingly passing by each other in a temporary sensor shadow, might actually be pausing just long enough to link to each other's access jacks via fiberoptics and switch egos. In this manner, an ego can jump to an entirely different morph without leaving a mesh trail or doing so in front of the cameras. Do this several times, and it can become impossible to track where an ego originated with one synthmorph and where it disappeared. Synthmorphs, by their nature, have other advantages that can be used to foil tracking. A small synthmorph or biomorph can be hidden inside another synthmorph as it moves about, until it is carefully released in a sensor dead zone. Likewise, some synthmorphs are easily disguised as robots operated by an AI rather than an ego, especially if you take pains to conceal the cyberbrain within its carriage. The same trick used to switch egos between synthmorphs described above can also be used to pass an ego from a ghostrider module to a previously uninhabited synthmorph or pod—again, without leaving a trail on the mesh. If care is taken, it is even possible for an ego to take over a synthmorph by force. First, the synthmorph must be incapacitated with a disabler, long enough for the attacker to initiate a cyberbrain hack that forces the target ego out into an external storage device. The invading ego then assumes control of the cyberbrain and voila—they are in control of a new shell.

Swarmanoid morphs deserve special mention, due to their ability to scatter into smaller swarms and even individual units to evade detection. Individual bots from the swarm can take separate, discreet routes to a destination, hiding in people's clothing, underneath vehicles, in luggage, and so on. The drawback to swarmanoids scattering for stealth purposes is that the swarm still relies on mesh communication to remain "whole" and act as a unit, meaning that they remain vulnerable to detection and sabotage. It is possible for individual swarm bots to be given preprogrammed instructions so that it may go mesh silent and act autonomously, but if something goes wrong it will be cut off from the rest of the swarmanoid's distributed intelligence.

FALSIFYING DATA

Almost all sensors are meshed, meaning they are vulnerable to hacking. A hacker who has accessed such a system can turn off recording, delete data, or replace it with falsified information. Turning a device off or leaving gaps in recorded memory are signs that someone has messed with a system, so the most discreet and effective method is to replace data with realistic misinformation. Simply looping previous recordings is not the best option, as archiving system AIs often scan recordings to look for exactly this sort of tampering. The best trick is to input data that is not just false but actively misleading, so that even if the hack is discovered the investigators may still be thrown off course.

Mesh system penetration can also play a critical role in ID checks. A skilled hacker providing overwatch on an operative may be able to get them through a checkpoint with a bad ID by infiltrating the ID scanner at the key moment and submitting false documentation.

One positive aspect to data manipulation is that it can sometimes be initiated after the fact, to clean up any traces an op might have left behind or to counteract anything that might have gone wrong. This is sometimes a tricky proposition, as data from meshed sensors may be archived in multiple places, so it may entail compromising multiple databases. Scrubbing the data trail left behind or the incriminating information linked to an ID can be a critical affair, however, especially if an operative needs time to extract themselves from a rapidly escalating situation.

MISDIRECTION

If you can't avoid detection for a crime, why not put that attention on someone else? In a high-surveillance society, it can be quite difficult to obfuscate all traces.

Odds are that something will be recorded, and that evidence is going to get someone blamed. The clever operative makes sure that person is never them. This means throwing a patsy to the wolves.

Quite often a patsy will be somewhat aware of what's going on, but they're somehow misled as to who is truly involved or what are the exact details of the situation. This often involves scams where the patsy is hired by a misleading source to be in the wrong place at the right time. Other times it means betraying the fall guy at the last minute. Sometimes it involves a ruse where the patsy believes the whole fiasco is an accident and their loyalty and honor will carry them through whatever punishment might come.

The patsy may also be someone who is completely oblivious to the situation's background—a stranger put in the situation by opportunity. An unknowing bystander makes for a great patsy, as even when questioned they're unlikely to spill useful information given that they're unaware of the context. The drawback here is that without some evidence of involvement, they may be difficult to properly frame. As the main point of using a patsy is to distract the opposition or authorities long enough for an operative to get away and/or clean up the trail, an uninvolved fall person may not consume attention for long enough.

On occasion it is possible to hire people as professional patsies. Some transhumans, particularly those comfortable with abusing forks, willingly subject themselves to the legal systems of various habitats, as taking the fall for someone else can pay rather well. Usually these sorts of accomplices will dedicate beta forks to the task, resigning any likelihood of merging with the fork. Some criminal cartels are known to sell forknapped egos for exactly this sort of purpose.

In the same vein, an operative can set up one of their own forks to take the fall. This is best done with a beta fork that has had all potentially incriminating memories excised. Ideally, they will be sleeved in a morph without a cortical stack, so that if they are killed there will be no memories of the operation that can be confiscated and interrogated via psychosurgery.

The Transhuman Factor

The weakest link in many security and surveillance systems is the transhuman element. Unlike machines, transhumans are riddled with biases, prone to errors, and easy to compromise. In this vein, the best method for dealing with a surveillance network, especially a large or sophisticated one, is to go after the transhumans that watch over it. Why bother subverting several dozen types of sensor systems when you can just go to the person in charge of that network and apply some pressure via blackmail, bribery, or outright threats? Such people are also vulnerable to misdirection, confidence schemes, or other scams that might divert their attention long enough for your operation. It is not always necessary to go after authority figures; run-of-the-mill surveillance techs are often capable of turning off a system at the right time, modifying data, or otherwise compromising a system within, without anyone being the wiser.

DARKCASTING OPERATIONS

No countersurveillance diatribe is complete without a nod to the importance of darkcasts. Without these illegal operations, getting to and from habitats would be a much trickier affair. Darkcast setups allow sentinels to egocast to a new habitat, bypass customs, get resleeved, employ a fake ID, do whatever needs to be done, and then upload and bug out safely, with no data trail of coming or going. Nothing is more useful.

Like everything else, darkcasting is not without complications. Most are run by criminal cartels that owe allegiance to no one. Credit is often the defining element of their relationships. This means that they can sometimes be compromised by oppositional elements that bribe them enough to hand over information about their clients' affairs. This is a rarity, however, as any darkcaster that does so will suffer an immense reputation hit should word of their lack of integrity escape. Nevertheless, it remains a possibility.

Similarly, operatives need to take care that they do not leave a trail back to the darkcast service. If habitat security manages to trace a sentinel back to their origin or exit point, they may be able to trace the operative even further than that. Though most darkcast operations do not keep records or backups of their clients as a precaution, a few unscrupulous cartels have been known to bend their rules out of greed. Even if your darkcaster's integrity is solid, leading the authorities to their operation can deprive you of a valuable resource.

GROUPS

Posted by: Bree Manning,
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Ever since the early days of computerized networking and widespread surveillance, transparency and privacy have been hot-button issues with certain small but vocal groups—especially computer nerds, cypherpunks, and civil libertarians. Right up through the Fall, many of these groups remained in the vanguard of raising concerns for debate and discussion, continuing on today albeit sometimes in new forms. Many others do not engage the issues as much as they exploit them, earning notoriety for their distinct approaches to the new panopticon paradigm.

ANON

Did your pod morph get puppethacked, forcing you to masturbate furiously in front of an award ceremony crowd? Was your entire fleet of AI-piloted workbots infected with a narcoalgorithm, sparking an impromptu factory floor dance party? Were your romantic private communications with a mercurial lover exposed just in time to ruin your chances at re-election? Was the climax of your vampire MARG infiltrated by a flash mob of pink unicorn avatars with rainbow blasts that burned the highest-level undead characters to ash? Congratulations, you were punked by Anon.

The hacker gang known as Anon is descended from a long lineage of griefer and hacktivist groups, dating back to the earliest decades of the 21st-century internet. Anon is often described as a mob of digital hooligans, and they have been known for mesh-based mischief and pranks that range from harmless and entertaining to damaging and malicious. They are, however, also known to engage in electronic civil disobedience and hacking campaigns for certain causes, particularly in support of leaks, freedom of information, and transparency and against censorship and countersousveillance. Their actions benefit from sheer force of numbers and the anonymity of participants.

Anon is rooted in intentionally informal structures. Anyone can join their online gatherings and chats where anonymity is mandatory. The group operates with a leaderless mob dynamic where operations arise out of causes that organically accrue a critical mass of popular support. In-fighting is common and expected, with Anon groups often splitting over certain issues. The driving force is not politics or ethics, but how many laughs can be derived. Critics note how Anon groups are vulnerable to external memetic manipulation and puppetnet infiltration, though Anon mesh nodes take measures to counteract this.

Though banned and persecuted in many habitats, Anon moots can be found in the hidden corners of almost any local mesh. In the inner system, most authorities consider Anon to be a front for anarchist and criminal operatives—or at best a haven for unruly teens and antisocial delinquents. There is some truth to this, as many autonomist subversives share an ideological affinity with Anon's causes and participate in Anon operations. Likewise, black hat hackers occasionally take a break from their black market businesses and lend their expertise to Anon ops for fun.

Anon groups can also be found in autonomist habitat mesh nets. Many anti-authoritarians enjoy the autonomy provided by the faceless social interactions in Anon moots, without fear of the impact it might have on their rep, as well as the way it puts everyone on the same level regardless of reputation. Some autonomists dislike how it enables social action without accountability, and there is also concern that hypercorp agents may take advantage of autonomist Anon groupings as a shield for their sabotage efforts.

DATACIDE

The secretive members of Datacide believe that current-day mesh databases go too far in compiling and correlating the private information of individuals. Dedicated to promoting privacy, this hacker crew focuses on infiltrating and sabotaging mesh archives, particularly those that are private, commercial, and not subject to oversight. Their favorite targets include consumer marketing databases, private ID information providers, and private intelligence and data

collection firms. Datacide attempts to permanently erase stored data when possible, also sabotaging the archive servers. Given that these databases are often backed up with redundant archives, Datacide has become particularly skilled at writing exploits and programs that infiltrate a system, linger for months or years to spread into all possible backups, and then strike all at once to eradicate both the full database and recent archives.

Decepticons

Conceding that the battle to stop documentation of people's private details and lives was a lost one, the Decepticons have taken a different approach: make this data unreliable. Decepticon hackers work hard to penetrate mesh databases and seed false information. They have released numerous worms and trojans into the wild with the sole purposes of gaining access to archives, selecting random entries, and replacing the data with autogenerated material (similar enough to pass, but false). Some of these worms are sophisticated enough that they defeat the autocorrecting and fact-checking features and AIs used by some databases to keep their material accurate. The Decepticons do not stop with selective alterations, however. They have also initiated automated networks to scrape real identities and personal details from various sources that are then used to register new accounts and customer transactions, except this time adding new false data alongside the correct details, to better pass as authentic. They have also been known to completely fabricate identities, news, and events, seeding the mesh with details on people and things that never actually existed. Though the cabal of Decepticon hackers is believed to be small, the AIs they employ to fabricate photo, video, and other sensor recordings and data are quite sophisticated. More than one major news outfit has been forced to retract reports after being fooled by Decepticon-seeded fake data. Likewise, many random people have found their lives made more difficult by the seeding of data that they cannot disprove, deny, or remove.

Ego Union

Ego Union is a civil rights advocacy group that campaigns on behalf of forks. They hold the simple position that alpha, beta, and even delta forks are each individual and sapient persons and should be treated with full equality (they also support personhood status for AIs). According to the Ego Union argument, forks diverge from their originating ego the moment they are separated. They strictly oppose non-voluntary merging. The union has been involved in some high-profile cases where forks attempted to seek asylum, emancipation, or even protection from deletion.

Considered a terrorist group in the Jovian Republic and a few other jurisdictions, Ego Union supporters have been linked to a reported "underground railroad" that supplies forks with new identities and darkcast passage to a station more supportive of fork independence.

Electronic Future Foundation

Descended from a group that defended civil liberties in the early days of network computing, the Electronic Future Foundation (EFF) continues to raise public awareness and promote legislation and policies that protect privacy, promote transparency, and protect people's rights when it comes to the mesh and digital activities. They are close allies of the argonauts, with significant overlap between the groups. The EFF is known to operate

anonymization, crypto-cred, and other privacy enhancement projects. Currently they are one of the leaders in the fight against indentured servitude and to release infugee egos kept in offline storage or locked in restrictive simulspaces/systems. They also battle against digital restrictions on nanofabrication, restrictive fork laws, and the criminalization of AIs and AGIs.

HIVE MIND

Hive Mind is a volunteer data verification network. Its members crowdsource efforts to fact-check online sources, squash mesh rumors, debunk urban legends, rate the accuracy of government and hypercorp claims, validate scientific papers, and verify real-time newsfeeds. Hive Mind accuracy ratings are considered the final say by many people. Hive Mind is also responsible for maintaining and updating numerous online resources, including the Solarchive project, the Earth Information Repository, WikiNews, the Galactic Vid Archive, and similar encyclopedic information sources. Though Hive Mind projects occasionally suffer from vandalism, seeding of false data, or claims of non-professionalism, they have shown a remarkable ability to self-correct and are often considered more reliable and less biased than official and professional sources.

MESH LEAKS

Many organizations have come and gone over the decades that sought to provide a public outlet for whistleblowers to post their insider information anonymously and without fear of persecution. Thanks to henchmen rewards, the need for leaks outlets in some jurisdictions has passed. In polities where the government, military, and hypercorp elites are still evading transparency, however, Mesh Leaks remains a powerful equalizer, exposing the elites' lies and lack of ethics. Though many other leaks-dedicated groups exist, Mesh Leaks is the most well known and respected, in part because they have the infrastructure to adequately protect their sources. Despite being illegal and favored on censorship blacklists, Mesh Leaks is quite adept at circumventing efforts to silence their newsfeeds as well as avoiding persecution.

Mesh Leaks archives exist as mirrored, decentralized sites, often linked together via dedicated darknet VPN connections. The specific leak archives are kept distinctly separate from submission points. The channels provided for people to submit information are heavily encrypted and set up to automatically anonymize the sender. These input points are also temporary, closing down and popping up elsewhere on the mesh, in order to avoid blockades or attempts to undermine the process.

Submitted material is carefully analyzed, scraped of identifying metadata, and verified by a legion of volunteers before being released. On occasion, Mesh Leaks has recruited help from the likes of the argonauts or even Hive Mind to help verify data. Mesh Leaks continues to have a somewhat hostile relationship with hypercorp media outlets. To the leakers, the media are co-opted and quite literally owned and so simply aren't doing their job. The media consider the leakers to be dangerous amateurs and criminals tainted by anarchist ideology, but at the same time they cannot afford to ignore their impact.

Mesh Leaks has at times been supported by Anon, the EFF, argonauts, and other transparency advocates. There has been criticism of leaks that endangered people or spread information concerning the TITANs. Mesh Leaks strives to avoid taking specific ideological stances, but various smaller anti-secrecy groups pursue whistleblowing in accordance with a particular agenda. Examples include MarsLeaks (anti-hypercorp, pro-Barsoomian items), ExoLeaks (coverage of gatecrashing and extrasolar exploitation), and Unnatural (anti-tech bioconservative bent).

SOURCE

The Source bills itself as decentralized journalism, by the people and for the people. The Source uses low-cost options to establish itself as a newsfeed via the mesh. Anyone can contribute news to the Source, in the form of live feeds, recordings, or other media. The submissions process is crowdsourced, with volunteers and AIs combing through and rating new input. The highest-rated pieces are elevated to the Source's primary newsfeed channels. Submissions are also contextually tagged for people's personal muse news filters to more easily sort out the material that most interests them.

Despite being a largely volunteer, ad hoc, noncommercial operation, the Source often competes with mainstream newsfeeds and aggregators (much to the chagrin of various media hypercorps). The Source has occasionally been tainted with falsified news items (blamed on both Anon and the Decepticons), and is criticized for its vulnerability to outsiders gaming its submission ratings system.

SPINTERNET

Spinternet is a professional outfit of mesh memetic mercenaries. Spinternet personnel include a cadre of elite hackers, equipped with massive puppetnets and other online propaganda resources. These mercs sell their services to interested parties and then engage their opponents in online memetic warfare. Hypercorps use the likes of Spinternet to counter leaks and other smear campaigns. Politicians bring these digital warriors in for astroturf campaigns, making it seem like they have a larger groundswell of support while viciously undermining their opponents. Spinternet has even been successful in derailing Anon campaigns in certain habitats. Though many similar hypercorp outfits exist, Spinternet is widely regarded as the most effective.

AUDIENCE PARTICIPATION

Posted by: Bree Manning,
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No discussion of our ubiquitous surveillance society is complete without a look at the people behind the cameras. One of the unique aspects of daily life is not just that we are surrounded by sensor-equipped devices that record us, but that we are likely *actively monitored* at any given time. Your everyday activity is likely to be surveiled by people-watchers, random folks browsing for something interesting going on, bored security AIs and infomorphs whose job is to scan for signs of suspicious activity, and griefers and criminals looking for their next mark. Your lifelog/X-cast may have a fan base, voyeurs who keep up with minute details of your daily experiences. So let's take a look at the people doing the looking.

INTERMITTENT SPOTTERS

If a reputation falls and nobody is there to see it, does it truly fall?

Fortunately for most, this isn't a pressing concern. The vast majority of transhumans are too busy with their own lives to spend large amounts of it watching others. Even those who subscribe to lifelogs and X-casts often have their muses whittle down the highlights into manageable chunks.

Nevertheless, many transhumans do intermittently have their eyes on others, simply as part of their daily affairs. We often check up on friends by surveiling the area we know them to be in, so we can get an update on their situation without needing to bother them directly. We access the interior cameras of shops, and restaurants to see how crowded they are before we go. If we're trying to contact a friend lurking in privacy mode, we may check out the sensor feeds from their common hang-outs to see if we spot them. Parents keep a watchful eye on their children. When driving somewhere, we may ping the traffic cams to see which route is least congested. By the very nature of our society's transparency, we each end up watching over the shoulders of others multiple times a day. At any given time, the number of transhumans watching the world is almost as high as the number actively participating in the world.

Not all of our casual surveillance uses are positive. Bosses periodically snoop on their employees' activities, to keep an eye on productivity. Jealous people may spy on their lovers, looking for signs of infidelity. Competitors may keep tabs on each other's activities, looking to gain an edge. Paranoid residents spy on neighbors they deem untrustworthy out of prejudice.

We also use these tools to balance, enhance, and manipulate our social interactions. If we hope to avoid running into someone, we scan the areas ahead of us, or locate them first. If we want to find where our friends are hanging out, we look. Or maybe we're too busy to hit the club tonight, but we'll check in on the dance floor's live feed and experience it vicariously. When we develop romantic interests in someone, we are likely to investigate their lives to find out more about them. Some new romantic partners take this a step farther, engaging in simultaneous voyeurism as part of their courtship. Some go as far as to grant each other privileged access into their private areas and private lives, offering a deep level of intimacy with no strings attached.

HOBBYIST VOYEURS

Some people simply enjoy watching others. There's a certain romanticism in watching the world turn. For most of us, that romanticism falls short when one realizes that most transhumans live rather boring lives. For this reason, full-time voyeurism is rarely a hobby undertaken for long.

There are enough people engaged in social voyeurism to make it a noteworthy phenomenon. Many services, in fact, rely on crowdsourcing surveillance work to people who make little or no money from the endeavor. Numerous security hypercorps allow public access to cameras watching over their clients' holdings, with rewards offered to anyone who reports suspicious activity or crimes. News outfits offer payouts to those who point them towards public sensor feeds that happened to capture newsworthy events. Many voyeurs aren't interested in rewards, however. To them, the act of watching is an obsession. They are fascinated with knowing what is going on, with watching over what people are doing. There is a thrill gained from the one-way transaction of spying on others without their direct awareness.

Some think that this form of hobby surveillance is a means of control. The voyeur looks on in the way a child might look on to an ant farm. Knowledge of others' activities and behaviors is empowering, especially when not reciprocated. Though there is no direct malice involved, it does bolster feelings of superiority—many voyeurs are thrilled at viewing people in their weakest moments, being happy to find people more pathetic than they are. It is no surprise that many hobbyist voyeurs embrace privacy shrouds when in public.

The same element of control is evident among vigilante voyeurs that go out of their way to monitor criminal elements. Though these watchful eyes have been known to impede some criminal operations, there have also been repercussions and backlashes from those who do not appreciate wanna-be crimestoppers messing with their affairs.

FANS, STALKERS, AND PAPARAZZI

A step above and beyond the hobbyist voyeurs are those who idolize and obsessively watch over others. Following celebrities is the most socially acceptable form of hobby surveillance. While X-casts and lifelogs are common sources, the old fashioned method of spying via cameras and microphones is more popular for the hardcore hobbyist.

Most celebrities came to the realization long ago that their privacy is forfeit—as did the companies

that pay them. In the inner system, icons who can't manage a public lifestyle may find themselves cut off, lest their dropping reputation come to smear the media corps. Most hypercorps protect their investments, hiring memeticists and lifestyle managers to coordinate a celebrity's public image. Metacelebrities are increasingly becoming common, in part because they function well as micro-managed icons.

Why watch someone else's life? The typical answer is, "because it's more interesting than my own." While that can certainly be true, long-term celeb stalkers usually have other reasons. The nature of transhumanity is one of transformation, of changing appearances and forms. Over time, that has a lasting effect on many minds. What if you could look like whatever you want, but you couldn't *be* whomever you want? For most voyeurs, this is the root problem. A cool and exciting morph doesn't change who you are fundamentally. No matter what shell you jump into, you're still yourself. You still do the same silly things you used to. You have the same tells, the same colloquialisms, and the same insecurities. This is why entertainment still exists; icon voyeurs just take it to an increased level. They live the lives of their icons vicariously, in place of their own.

In extreme cases, when one follows another's identity for long enough, one begins to absorb it, to own it. Before long, the voyeur may refer to the celebrity as "we" when uncalled for. The hobbyist becomes unnecessarily defensive of the subject's choices. Those critical of the icon become enemies. Many celebrities have small legions of fans that follow their every move and rush to defend their reputation. The smart icons learn to manipulate these followers to their advantage.

One phenomenon that arises from this particular fetish is celebrity imitation. If one wants to be watched, what better way than by impersonating a celebrity? This is hard to maintain in earnest, though it has been known to fool some fans for short periods. Most impersonators are brazen about their intentions, relying on humor and kitsch appeal. They also tend to impersonate dead or retired celebrities, ones not expected to maintain a following. The solar system has one notorious Elvis Presley impersonator with a handful of near-religious followers. While they know he's not The King, they don't let that get in the way of their hero worship. A few eccentric fans have gone so far as to undergo voluntary psychosurgery to fundamentally change their knowledge of the fact, becoming true believers. A brief fad of impersonating religious figures in recent years has failed to gain much momentum for the impersonators, though some have developed small cult followings.

Digital Security Watchers

Complex security systems require full-time maintenance and tending. Ubiquitous surveillance means that there are more camera and sensor feeds than there are physical eyes to watch. Though software automates many tasks and can monitor sensory input for signs of suspicious activity, the availability of AIs and infomorphs is irrefutable. AIs are easily copied, meaning that any surveillance network is likely to have as many as it needs. Infomorphs are a cheap source of labor, even more effective than AIs. In many habitats, space is at a premium, morphs aren't cheap, and job opportunities are limited, making security work an ideal situation for disembodied egos.

AI and infomorph security agents are invaluable. They don't take smoke breaks. They don't fall asleep on the job. They're intimately familiar with every little exception to protocol that occurs on their watch.

Unlike an AI, infomorphs understand the subtle nuances of life that no machine truly can. An infomorph is much more likely to have an intuitive understanding of a complex situation than any weak AI ever will. For all the value in these egos, however, they suffer the same frailties that plague the rest of transhumanity. They may view a situation through the lens of their own particular cultural bias, for example, or they may be vulnerable to temptations such as blackmail and bribery. The weak point of many security systems is defined as the transhuman element, and infomorph watchers both counter and exacerbate this fact. Theoretically,

INDENTURED INFOMORPH WATCHERS

For some infomorphs, security work is less a choice, more an obligation. Indentured infomorphs serve long terms of menial labor in order to earn a body. Security is far from the worst assignment, and many infugees jump at the opportunity. The demand makes these limited jobs quite competitive, which the hypercorps use to their benefit. The smallest failures can be interpreted as a breach of contract, terminating the indenture's earnings and replacing them with the next enthusiastic worker in line. When the alternative to security work is mining, terraforming, and other manual labor in a cheap and uncomfortable case, security indentures don't let go of jobs easily. While they are less talented than many professional security infomorphs, they're ironically less likely to fall to bribery and other corruption as the risk is just too high.

On the flip side, some indentures are naturally resentful of this situation. They have been known to install backdoors into systems, sell security secrets to outsiders, or on occasion aid and abet those they are supposed to be guarding against. A few have claimed whistleblower prizes on their employers after brutal and improperly handled security incidents were covered up. For this reason, many hypercorps treat their indentured security infomorphs with care, keeping almost as careful an eye on their activity. ■

the watchmen can also be watched, but only the most paranoid security operations go to this length. Most colonies recognize these failings, and understand that without a modicum of respect and trust, no number of security officers will ever be effective. On the other side of things, it guarantees that there's always room to bend the laws, overlook rules, and otherwise take advantage of imperfections in the system.

Given the availability of AIs and infomorphs, they are not just used to protect and overwatch secure systems. They are frequently employed as a preventive deterrent, watching through publicams and also private sensor networks to which they have purchased or obtained access. These watchers spend their time scanning for suspicious activity, running recognition scans against databases of wanted/known morphs, and analyzing the behavior of random subjects. More than one terrorist plot and criminal operation has been preemptively busted by keen-eyed infomorphs that picked up on subtle clues.

AGIs take on the same roles that weak AIs and infomorphs fulfill. Some habitats embrace AGIs as they are more effective than AIs and more at home in the mesh than other infomorphs. In much of the system, however—particularly the inner system—AGIs are not trusted when it comes to surveillance and security matters. Too many people fear that putting the keys to their society in the digital hands of machine intelligences will inevitably lead to another situation as occurred with the TITANs.

One drawback to digital security is that it is confined to areas with sensor coverage. For this reason roaming patrol drones are also incorporated into a surveillance network, enabling AIs and infomorphs to investigate off-sensor areas remotely. Synthmorphs and pods are also sometimes made available for puppeteering, giving such watchers a more direct physical counterpart.

Physical Security Watchers

Physical security assets are often treated as secondary to digital watchers for surveillance duty. The most secure facilities, however, realize that AI and infomorph watchers have several distinct vulnerabilities: they can be hacked, jammed, and isolated. Serious security set-ups therefore incorporate physical security as a layered defense, with overlapping surveillance duties.

Griefers and Criminals

On the other side of the proverbial fence, many voyeurs are using surveillance networks for illicit purposes. Griefers remain a persistent annoyance, using omnipresent sensor nets to gain information on and harass their targets remotely, purely for laughs. Griefers also tend to operate in packs, increasing their ability to saturate an area or target with coverage before they initiate their campaigns.

On a more sophisticated level, criminals were among the first to take advantage of ubiquitous surveillance for their own purposes. Targets can now be thoroughly cased and evaluated beforehand, and the positions and response of security forces and police can be monitored. Criminal cartels are also careful to keep an eye on rivals.

The State of Privacy

Source: Electronic Future Foundation [Link]

The habitats and polities of the solar system are chaotic terrain when it comes to issues and legalities of identification, surveillance, and privacy. An unwary egocasting traveler can very easily find themselves in a jurisdiction where they are subject to more scrutiny and less protections than they are used to or willing to accept. To analyze the different conditions, we've broken down transhumanity's colonies into four types of societies. While these definitions are loose, they provide a good springboard for correlating local stances on specific issues.

Transparent

Transparent polities are the norm. In these habitats, there is a good balance between surveillance and sousveillance as well as transparency and privacy. Examples of transparent habitats include: Erato, Octavia, Progress, Selene Station, and Valles-New Shanghai. Policies sometimes stray towards Open and Closed models; every habitat has their own policies and standards.

Transparent Example: Valles-New Shanghai (Mars)

The largest metroplex in the solar system is a model for transparent societies. Publicams and other sensor spimes are everywhere, all open for public access. Many private cameras and sensors also surveil public areas; these are accessible at a price. Sensor nets in homes, business offices, high-security zones, and some other areas are private access only. Security/police can gain access with a warrant and can review the logs of emergency sensors if an alarm is tripped. Most people lifelog, with a significant amount doing so via public feed (or at least partially), and many X-cast. Many civic and political leaders do the same on public feeds, at least while on the clock. Officers and vehicles of the People's Militia carry sensors that broadcast publicly, though these have a habit of failing, and some squads are intentionally deployed in private mode. Hypercorp officers tend to avoid the public eye, with a few notable exceptions. Civic offices, government sessions, security stations, and courts are open access.

Mesh privacy mode is allowed and tolerated and anonymization services, cryptography, and crypto-cred are legal. Nanotat IDs are required for all morphs and brainprint and digital code ID are required for all egos. There is no checkpoint or customs requirement to enter or leave the city, but thoroughfares in and out of the domes are heavily monitored. The People's Militia monitors publicams, their own sensor networks, and

a flotilla of patrol drones and are also plugged into many privately owned spynets with coverage of public areas. Militia officers profile people on the street and conduct random ID stops in some parts of the city, particularly wealthier neighborhoods. Private security contractors also monitor and protect some neighborhoods and private/corporate facilities. Both the militia and private contractors crowdsource public help in monitoring sensor feeds, offering rewards to those that trigger alerts resulting in arrests. Probability and precog systems are used to identify potential criminal hot spots so that such areas can be swarmed with extra surveillance and physical coverage. Henchmen prizes are offered for whistleblowing on illegal administration or militia activity, but there is a strong internal culture that applies social pressure against snitching and ostracizes those who do.

Closed

Closed stations curtail the amount of sousveillance allowed to the public, also typically putting more emphasis on government/security surveillance while otherwise restricting civil liberties. Examples of closed habitats include: Aspis, Liberty, Pathfinder City, Remembrance, Vo Nguyen, and Xiphos.

Closed Example: Liberty (Ganymede)

The capital of the Jovian Republic is a model of a closed society. Publicams and other sensors in public areas are open access, but are subject to security takeover and lockdown by the authorities. Privately owned sensor nets must also be made accessible to the security apparatus. Though private residences are theoretically off-limits, Jovian security has the authority to monitor anyone they suspect of criminal or subversive activity. Though many Jovians lifelog, very little of this is made publicly accessible, instead being made available only to friends and family. X-casting is almost non-existent. Few (if any) leaders lifelog publicly.

Civic, government, and security property is protected by private sensor nets accessible only by Jovian police. It is illegal to surveil these facilities, just as it is illegal to record police activities. Mesh privacy mode is tolerated but subject to security override. Anonymization services are illegal. Crypto-cred is restricted; cryptography of any sort must be licensed from the government and is presumed to have back doors for security access. Whistleblowing is frowned upon and often prosecuted.

Biometric IDs are required for all morphs. Since resleeving is a restricted technology here, there is no need for morph nanotat IDs or brainprints, though these are recorded from non-Jovian visitors. Access to the habitat requires a strict set of security checks and customs procedures involving a number of sensor scans. Psychosurgery interrogation is not uncommon. Non-Jovian visitors are usually restricted to specific areas and subjected to mandatory overwatch monitoring by security surveillance bots. Jovian police are known to set up temporary checkpoints and to make heavy use of spy drones.

Open

Open colonies are the epitome of transparency. Examples of open habitats include: Extropia, Gerlach, Locus, and Nyhavn.

Open Example: Locus

As the premier anarchist habitat, Locus embodies many of the ideals of an open society. Publicams and other sensors are everywhere, accessible to everyone. There are no private sensors outside of private residences, as anarchists do not acknowledge property above the level of necessary or sentimental personal possessions. There are no government or police authorities to monitor, but the various collectives, cooperatives, and syndicates that play major civic roles are all transparent and accessible. Almost everyone lifelogs and posts much of it publicly; X-casting is also common. The individual residents collaborate on keeping an eye on things together. If something goes wrong or an anti-social crime or act of sabotage is committed, one or more volunteer response groups will spring into action.

Mesh privacy mode, anonymization services, cryptography, and crypto-cred are all available though sometimes discouraged. Nanotat IDs for morphs are not required, but many people use them anyway in case something happens to their morph. Likewise, brainprint and digital code ID are not required, but are used as a matter of course for simple logistics.

The residents of Locus do require that visitors declare any allegiance to hypercorp or government interests when you arrive, but there is no vetting of IDs. Security scans ensure only that no one is bringing aboard weapons of mass destruction.

Private

Private habitats strongly discourage both sur- and sousveillance. These are few and far between.

Private Example: Legba

Here, publicams and all other stationary sensors are banned from public areas. An "each to their own" philosophy pervades here. Private sensors are only allowed in private dwellings, but consent is required to legally record visitors. Likewise, lifelogging is only allowed to the extent that you must receive permission from others before you record them. X-casting is similarly limited. The police have the authority to surveil high-security areas critical to the habitat, but are only allowed to surveil public and private areas when warranted by ongoing investigations. Mesh privacy mode, anonymization services, cryptography, and crypto-cred are all legal. Nanotat IDs for morphs are not required, but brainprint and digital code IDs are still required for egos to resolve legal matters.

HABITATS

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Source: *Firewall Resources for the Newly Revived* [Link]

If you're here, chances are that you've spent a long time in cold storage or simulspace. Welcome back to the world of the physical. That also means you're probably used to life back on Earth before the Fall. It would be an understatement to say that a lot has changed. You will need time to get used to life out here. It's natural for you to feel excited, even euphoric, at the moment. You have survived and persevered where so many did not.

It also is entirely natural for feelings of sadness, unease, guilt, and even fear to set in once you start to grasp the reality of what you lost in your old life and just how different your new one is. Just know that you don't have to go through it alone and that there isn't anything wrong with you. We have counselors available and we hope that you will form bonds with your fellow egos in this orientation.

Some of you will be going on to other stations and colonies shortly after you are medically cleared, so we're going to take the time to go over the fundamentals of life in space. We don't want to overwhelm you, but it is important that you be equipped with knowledge that is both essential and helpful. If something we discuss is unclear or confusing, don't hesitate to stop and ask questions.

NEW HOMES ON THE FRONTIER

Source: *Lectures on Space Habitat Systems Engineering & Design,* Prof. Iona Stormgren, Titan Tech [Link]

By modern standards, the first space habitats—Salyut, Mir, the International Space Station—were crude pressure vessels (they were called "tin cans," even back then) barely capable of protecting their crews against a hostile space environment. Those initial attempts at sustaining human life beyond Earth's atmosphere taught our predecessors crucial lessons, though. They learned how to build large structures in microgravity as well as how to avoid the degrading effects of atomic oxygen, radiation exposure, and micrometeoroid impacts on exposed materials. They realized just how ill-suited the baseline human body is for long durations in space. Without these lessons, the Fall would have been the end of human civilization.

The first stations at the Earth-Luna Lagrange points and in orbit around Mars took advantage of more efficient waste removal and recycling of air and water. They could even grow some of their own food in plant growth chambers or hydroponics bays. Advanced solar arrays concentrated the sun's rays on smaller panels with higher conversion efficiency, increasing available power and greatly reducing the structural requirements of these stations. They were still fundamentally dependent on terrestrial industry for major components and long-term sustainability, however. These outposts were typically public-private partnerships that allowed scientific research, industrial R&D, and government-backed exploration projects to carry on simultaneously.

The expansion of hypercorps into space to escape the increasingly intractable socioeconomic and ecological problems on Earth pushed the situation to the next level. Combined with the development of advanced biotechnologies, machine intelligence, and the space elevator, space habitat construction entered a kind of second generation. Humanity had—as long dreamed of by engineers and literary prognosticators alike—the situational awareness of the space environment, the technological means of mitigating its worst effects, and the economic drive to establish the first habitats truly independent of Earth.

While the resupply of consumables (such as water and oxygen) was still required, infrastructure was available for local resource utilization. Once it became cheaper to mine volatiles from near-Earth objects or permanently shadowed craters on Luna, the proverbial cord was cut. Design considerations were dominated more by the mission requirements of each specific habitat and local needs rather than the payload size and lift capacity of a booster launching from Earth.

Mining operations tended to favor clusters and beehives, as they made the most efficient use of existing materials and available structures. Surface stations on Mars and Luna increasingly adopted dome structures because a large surface area could be quickly enclosed, pressurized, and made available for development akin to cities on Earth. The first torus habitats were built at the Lagrange points to accommodate research and manufacturing that required gravity. The inherent volumetric limitations of the torus design led to the construction of O'Neill cylinders and Bernal spheres that allowed permanent habitation for even Earth-born immigrants.

The third generation of space habitat design and development was initiated with the availability of nanotech assemblers and digital consciousness. While third-generation development stalled during and after the Fall, the demand for new habitats to alleviate congestion on existing platforms and the emergence of widely disparate transhuman factions have incubated space habitat designs previously unimaginable. Saturn's famous Hamilton cylinders are, perhaps, the best example of this because of their ability to

self-assemble and reconfigure to the size and needs of large populations.

Though many post-Fall habitats have sought to recreate the lost Earth through cityscapes and nature preserves, much of transhumanity has instead chosen to adapt itself to the local environment and build homes accordingly. Coronal habitats represent one extreme, designed specifically to shelter the suryas, salamanders, and their rare visitors from the Sun's direct fury. Processor loci inhabited solely by AGIs and infomorphs can be said to represent another. Nearly any configuration imaginable is possible when the only constraints are the laws of thermodynamics and the availability of economic resources.

PURPOSE

Source: *Lectures on Space Habitat Systems Engineering & Design*,
Prof. Emeritus Jack Carlson, Titan Tech [Link]

The basic needs of corporeal beings are food, water, and shelter, so the old Earth saying goes. While the first two are either negotiable or cheap with uploading, advanced biomods, cybernetics, and cornucopia machines, the universe is still a pretty dangerous place. Every day, someone somewhere is dealing with a coronal mass ejection, or the problem of heat rejection into a vacuum, or collision damage from some kind of debris, or the effects of galactic cosmic radiation. For every solution we think we've come up with to maintain our supposed technological immortality, there is something out there that can defeat it.

Whatever we do, then, for food and water, we still need shelter. It's our armor against the universe. Without our space stations, warrens, beehives, cylinders, and everything else, all of us would have been at the mercy of the TITANs. That is, if we hadn't drowned in our own filth on the homeworld first. Some of you are old enough to know what I'm talking about or experienced it yourself. I knew we were finished if we didn't get off that rock, so that's just what I did.

I traded my youth for the chance to build domes on Luna. As soon as that contract was up, I hopped out to the Belt and worked on the first Cole habitats in return for zero-g biomods. From there, I rode the wave out to Titan and I've been here ever since. I know all you want to hear about is the Hamilton cylinders, but bear with me. You've got to understand where we came from if you're going to be any good at taking us into the future.

A good habitat engineer understands the threats out there and devises a strategy for avoiding unnecessary risk as well as mitigating those you have to accept to satisfy the requirements of the project. Lest you idealists forget, we build habitats for a reason. Unless you ever get rich or lucky enough to do your own thing, habitats aren't there for our own personal edification. A quality product is one that meets your stakeholders' requirements, simple as that. If you can't handle that, go take your chances at Locus.

Still with me? Good. One of the things you'll have to learn once you get beyond Titan's warm embrace is how to deal with old codgers like me. I've been building space stations since before the Fall and I'll keep doing it long after some of you do something stupid and get your stack popped. Don't think it can't happen to you. I knew a guy whose work team got fried by a gamma-ray burst from God-knows-where.

The basic purpose of any habitat is to keep its inhabitants alive and safe from whatever is outside. The coronals are a perfect example, even though I think they're a bit crazy. Giant honking electromagnetic field generators surrounding an immense core of water, all to protect a zero-g cluster at the center. That's ultimately just physics and engineering, though. Figuring out why you would build something like that in the first place is what really drives the problem. That's the key to defining the trade space for your design, satisfying your project's sponsors, and delivering the best product.

Let's consider a few examples. Building a colony is all about keeping the most people alive in the volume available for the least amount of resources consumed. Ask yourself, "what is the target population?" I'm not just talking about numbers of bodies. What level of gravity will they require? How much water, air, and food will they consume? How will you provide those consumables? How much radiation protection do they need? What local resources are available to meet these needs? Building an O'Neill cylinder out at the Earth-Luna L5 point gives you a lot of pressurized volume, a relatively simple way to provide artificial gravity, and fairly effective protection against even cosmic rays, but requires a significant outlay of initial resources to build the damn thing and sustain regular resupply.

Mining operations are mainly concerned about accessing and producing raw materials. A small outfit with razor-thin margins is probably going to stick to breaking up rubble piles and small metallic globs that get lost in hypercorp overhead budgets. If they can't afford biomods for zero g, you're looking at a tin can spun on a tether for minimal gravity. More established operations working on larger objects have the resources and the time to provide more permanent housing for their workers. Even then, they're looking to save costs. Typically, they'll cap the boreholes and seal the walls with an impermeable plastic membrane or rock melt. Clear the dust, pressurize the volume, and you've got a standard beehive.

Waystations exist solely so interplanetary spacecraft don't have to carry all the fuel they need to get to a given destination. Even with increasingly more efficient propulsion systems available, no one wants to carry reaction mass and the containment for said reaction mass if they don't have to. Quite

a few infomorph habitats keep themselves going by providing this function. They get to stay out in the middle-of-nowhere and do whatever it is they do in simulspace. The best part for them is that other people pay for it since they provide a valuable service. For unmanned cargo resupply, we're talking minimalistic structure, enough radiation and micrometeoroid shielding to keep things from breaking down, along with huge fuel tanks floating in space. Maybe a sunshield if they're storing cryogenics. Only a handful of these places provide amenities for passengers, since most people that go for physical embarkation prefer a fast ride on a fusion drive.

Industrial facilities, like shipyards and factories, aren't much different than waystations, in terms of engineering. The majority of the structure will be dedicated to microgravity manufacturing processes, which are almost always highly automated. It's all about processing the raw input, typically ores and volatiles from the mines, into useful products. The actual habitat portion of the facility depends on who or what the business operations are there to sustain. Cluster habitats are pretty popular because they're modular, reconfigurable, and fairly cheap. Biotech facilities stand out, though. It's still pretty hard to do bioengineering in either vacuum or microgravity. Torus habitats are not uncommon because they provide artificial gravity, but are smaller and cheaper than the big cylinders or spheres.

Building a research station is all about putting the mind of someone who's trying to figure something out where that something is. Location, location, location! If you want to study the space whales, that's what the coronal habitats are for. If you want to learn about the aquatic lifeforms of Europa or Enceladus, you get to live in what amounts to a fancy submarine. If you want to study Venusian geology without being incinerated by the heat and pressure that limited the first probes to seconds of lifetime, then aerostats hovering above those layers of hellish atmosphere are where you are least likely to die. Cosmic astrophysicists want to be as far the hell away from all the electronic noise and light the rest of us make, so a lot of them are heading out to the Kuiper Belt to dig holes for their sensors in the ice or establishing zero-g observatories on highly inclined, highly eccentric orbits. Get the picture?

Even giving the science types their due, most of what I've been yammering about is stuff that actually does some sort of good. You also have to keep in mind that, even considering we're still clawing our way back from near-extinction, there are still plenty of people out there with more wealth than sense—and who are looking for ways to show that. Before anyone asks, yes, I'm talking about MeatHab. You've also got people that want to play at being a mermaid and simulspace just isn't good enough. Beyond the absurd, there's also the uplift habitats with environments optimized to suit lifeforms that never existed in nature. Remember, it all comes down to what your customer wants and what they can afford. As the engineer, it's your job to make the trades.

HABITAT TYPES

Source: *A Mercenary's Guide to the Offworld Colonies* [Link]

I don't care how many brush wars are listed on your resume, working a security detail or launching an infiltration op is an entirely different paradigm when you're dealing with space habitats instead of hugging the dirt. Not only do you have to consider minor inconveniences like lack of gravity, but the proximity to hostile environments means that a simple hull breach could take out your entire squad in seconds. Every habitat used by transhumanity has an entirely different layout configuration and accompanying set of concerns when it comes to security and offensive ops. Air support and perimeter free-fire zones are going to do nothing for you in a close-quarters beehive skirmish, and in a Cole bubble or O'Neill cylinder your enemy may be directly overhead. This part of the primer will introduce you to the basics of each colony type.

The most common space habitats are familiar types that were used over many decades in transhuman space colonization efforts: tin cans, toruses, O'Neill cylinders, beehives, Cole bubbles, clusters, and the Reagan cylinders (more commonly called sarcophagus habs) used by the Jovians. However, experimentation and the special needs of a variety of environments have led to a number of more exotic habitat types.

AEROSTATS

Built to float in the carbon dioxide atmosphere of Venus, aerostats are essentially cities built as giant balloons. The breathable atmosphere filling aerostats is lighter than the surrounding atmosphere, so aerostats feature open areas with massive volumes of air that enable them to float. Aerostats are not pressurized, as the interior air pressure is roughly equal to the exterior atmosphere, meaning that there is no need for heavy airlocks, just airtight doors and bulkheads. Aerostats are constructed from lightweight but durable materials such as aerogels, diamond, and metallic foam.

Most aerostats are shaped like a balloon or upside-down tear drop. The center of each is a massive vertical air-filled chamber, reaching from top to bottom, that provides buoyancy. Other parts of the aerostat are built with large open airy areas and high ceilings. External parts of the structure may feature tall privately owned towers and open areas for synthmorphs that do not require breathable atmosphere.

Most aerostats are mobile, floating through the stable areas of the Venusian atmosphere. Occasionally an aerostat will tether itself to the surface at mining

or research outposts, allowing supplies and resources to be transferred via elevator cables.

Aerostats present would-be attackers or infiltrators with a set of challenges considerably different from space habitats. Aerostats don't have the large, active fleets of defense and harvester drones that space habs do, but they do have numerous landing bays for atmospheric craft. Life support aboard an aerostat is dispersed throughout the habitat's hull, consisting of little more than large banks of CO_2 scrubbers connected to a cooling and ventilation system. The accompanying networks of ducts criss-cross the entire habitat and can be extremely useful to lithe interlopers. At the same time, an aerostat contains large, open spaces that serve dual duty as public atriums and as chambers to hold the oxygen and nitrogen that makes the habitat buoyant. These big open spaces provide ample maneuvering space for robotic fliers and other small aircraft. These areas make it easy for hab designers to spatially segregate important administrative buildings from surrounding structures, something that can't be done in more cramped habitats. Getting aboard an aerostat is an easier job than infiltrating other stations, but striking at its heart can be much more difficult.

BATHYSCAPHES

This design is common to the subcrustal seas of Ceres, Enceladus, and Europa. Bathyscaphes were also built in the oceans of Earth, but it is unknown whether any survived the Fall. On Ceres and Enceladus, they are generally attached to the sea bed by massive anchors, while on Europa bathyscaphes are normally anchored to the highest spires of a lithodermic reef. Bathyscaphes are built up from clusters of spherical modules and are very similar on the inside to cluster habs elsewhere. Their exteriors, however, are designed for submersion rather than the vacuum of space. Their walls tend to be thicker, especially on Europa, where pressures beneath the planet's thick crust are much higher than in other oceans. Some are partially water-filled on the inside, with breathing pockets for neo-cetacean morphs. Airlocks include systems for spraying down those entering to rinse away excess ammonia or salt. Some bathyscaphes supplement reactor power with tidal harnesses designed to convert energy from waves or currents into usable power.

Bathyscaphes are difficult to infiltrate from the outside. Technician AIs keep a constant watch for hull breaches. Even if cutting through a hull does not generate an immediate security response, the flooding of the module that results from doing so will normally cause the module in question to be isolated from the rest of the hab.

Not all bathyscaphes are underwater. A few are used by gatecrashers in exoplanet high-pressure atmospheric conditions. These are functionally similar, though without the aquatic focus.

BEEHIVES

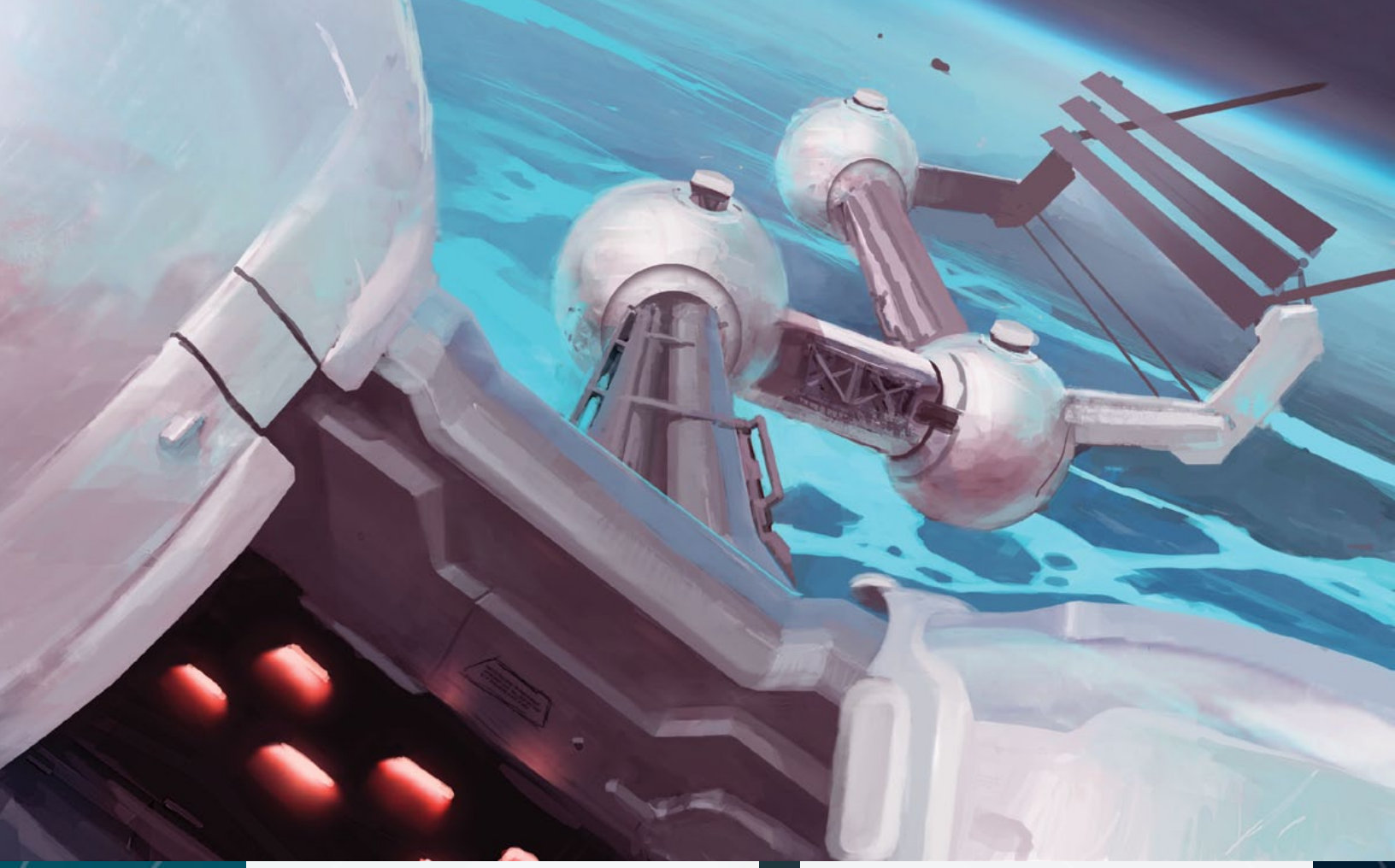
The most common habitat in the Belt or among other small planetesimals is the beehive. Tunnels burrowed into rock or ice, often in the wake of mining or exploratory operations, are converted into living spaces by either fusing the existing material or coating the walls with a sealant. Chambers are dug out of the host object and internally sealed in the same manner if additional internal volume is required. Access points on the surface are capped with airlocks, docking modules, or hard seals to prevent depressurization.

Beehives are interesting because they are built much like underground bunkers and warrens on the planets, but share the microgravity environment of tin cans and cluster habitats. For people without the training or mods to think three-dimensionally, this can make beehives a veritable labyrinth. Purpose-built beehive habitats use color coding and grid assignments to make navigation easier. Those adapted from mining tunnels or designed for internal security may not have such luxuries.

An asteroid, comet, or Kuiper Belt object has to be large or dense enough to hold itself together to be suitable for a beehive. Rock and dust piles or actively venting comets are just too unstable and usually aren't worth the energy expenditure to melt into a usable state. As a result, beehives are limited at the lower end to metallic asteroids approximately a quarter of a kilometer on the long axis. Population sizes vary from one or two dozen inhabitants and small communities of a few hundred to the ten million residents of Extropia.

Solar power is an option for beehive stations in the inner system, despite the fact that so many are built into irregularly shaped objects. If there is not enough surface area on the sunward-facing side(s), a power sat with constant collection and transmission capability can beam the energy via laser to receivers on the surface. In the Belt, smaller habitats often rely on Sterling radioisotope thermal generators continuously feeding a capacitor system that balances out peak and off-peak loads. Fusion generators are common in the outer system because of the abundance of hydrogen fuel.

Nuclear reactors (whether fission or fusion) are the generator of choice for stations with high power requirements, especially in the outer system where solar panels are dramatically less effective, but these habitats must carefully balance safety and security. If the host object is large enough, the generator can be installed behind enough rock or ice to effectively protect residents from radiation hazards and the reactor itself from outside attack. Beehives with an extended long axis will often concentrate the habitable volume on one end and the power systems on the opposite. The smallest beehive communities have even been known to use structural booms to take advantage of the inverse-square law and put the reactor out on the other side of a directional radiation shield, much like spacecraft.



BERNAL SPHERES

Bernal spheres are artificially constructed hollow spheres, built to hold atmosphere for inhabitants living on the inner surface, Bernal spheres are usually spun to provide residents with gravity along an equatorial strip, with gravity lessening higher up and reaching zero at the axis of rotation. A ring of mirrors direct sunlight to focal points that illuminate the interior via day and night cycles through large windows near the axis points.

Bernal spheres are regarded as less efficient than other habitat types since only a portion of the interior surface provides full gravity. Though designs have been produced for Bernal spheres up to 16 kilometers in diameter, most are much smaller, ranging from 0.5 to 1.5 kilometers in diameter and providing living space for populations ranging from 10,000 to 200,000. A few smaller spheres are also kept at zero gravity, providing ample internal air space for floating structures and flight-capable morphs.

Bernal spheres are often coupled with other station types, particularly cluster habs and toruses. Clusters are more common, housing the agricultural, industrial, and docking modules that the habitat needs.

From security and infiltration standpoints, Bernal spheres present several challenges. The axial access points provide a chokepoint for entering and leaving (though some models have escape pods with exterior access ports built into the structure for emergencies). Inside, most Bernal spheres are small enough that you can reach anywhere with a short 20-minute drive or train ride at most. Almost all areas of the sphere's interior are visible to other areas, making overhead surveillance, tracking,and targeting quite easy, even at range, except when large structures and terrain provide limited cover.

CLUSTERS

Cluster habitats are among the most ubiquitous in the solar system because of their inherent modularity and ability to accommodate expansion. Each module is designed to carry its own loads, so a nearly infinite variety of configurations is possible. Hypercorp clusters tend to be very orderly and arranged in a lattice formation to ensure high structural stability and maximize efficiency. Autonomist clusters in the outer system very much take on an arrangement that reflects the attitudes of the local populace. More communal groups will organize the modules and floatways to maximize access for every resident. On the other hand, individualist strongholds can be totally amorphous because only those residents who explicitly agree will share floatways and structural connections.

There are two things that really distinguish cluster habitats from tin cans. First, cluster habitats are designed with integral support for such technologies as the mesh, augmented reality, life support, and

nanomachinery. Second is the high degree of specialization available to cluster modules because they don't have to fit all of the habitat's essential functions in each module. Thus, a cluster habitat could have several dedicated environmental and life support modules distributed about the network providing processing for the entire system, like lymph nodes in a biomorph body. This allows the other modules to focus on their intended function—be it providing a centrifuge, laboratory volume, manufacturing, habitation, multiple airlock chambers, cargo storage, docking facilities, medical bays, or zero-g agriculture.

As a cluster habitat increases in size and mass, external trusses or structural spars may still be necessary to distribute the loads. Somewhat paradoxically, this can be especially required of the individualist habitats that maximize personal expression and choice over the efficiency of the entire system. As a result, only someone with a solid rep is likely to convince the inhabitants of an autonomist cluster habitat to add a module that might add overall stress to the system beyond that which the module's own structure can carry.

The availability of power systems for cluster habitats is just as diverse. Distributed power networks based on common generators, such as concentrated solar arrays or fusion reactor modules, are characteristic of inner system clusters. On the opposite extreme, individualist habitats may require each module to provide its own power or share resources with neighbors. Entire "neighborhoods" can be defined by their preferred power source, in such circumstances.

Many cluster habs contain tin can modules or mini toruses that are spun to create areas with gravity.

LaFrance Rigs

LaFrance rigs are a common configuration consisting of modules and spacecraft anchored in a huge pyramidal lattice of scaffolding with reactors and other utilities at the center. The non-spacecraft components vary between modern cluster modules and low-tech tin cans. LaFrance rigs are common in scum swarms and mobile mining operations. Their main advantage and difference from cluster habitats is their mobility. Phelan's Recourse, the massive swarm in Saturn orbit, contains several large agglomerations of ships connected in LaFrance rigs or otherwise lashed together.

Cole Bubbles

The original theory behind Dandridge M. Cole's "bubbleworld" habitat was to quickly create a hollow sphere by the expansion from flash evaporation of water inside a cavity dug at the center of a metallic asteroid. In practice, this turned out to be extremely difficult because few asteroids were homogenous enough to withstand this process without cracking along impurities. On top of that, the energy expenditure to soften the asteroid into an elastic state and flash boil the water are immense.

Instead, most habitats called Cole bubbles are created by a more controlled method. A suitable metallic asteroid is encapsulated in a thin polymer shell inflated to the desired radius with carbon monoxide at low pressure. The entire collection is heated until the nickel and iron in the asteroid begin to react with the CO gas. By keeping the shell at a constant temperature and with transport assisted by nanoparticle catalysts, the nickel alloys will deposit evenly on the interior of the shell until the heat is cut off and the reaction stops.

The fabrication shell can either be kept in place as a protective coating or recycled for other uses. Any remaining carbon monoxide, metal ore, volatiles, and silicates serve as feedstock for synthesizing industrial materials for the Cole habitat's internal systems. These can include composites and lubricants made from hydrocarbons and ceramic-metal hybrids. Like anywhere else, as many of the local resources are utilized as possible.

Cole bubbles left in microgravity are popular amongst neo-avians and transhumans adapted permanently for life in zero g because they can literally fly from one point in the habitat to any other, so long as any obstructions are accounted for. Water-breathing species share this affinity as well, though their habs must have significantly thicker shells to hold the water pressure. Cole habitats can also be spun for artificial gravity; the centrifugal effect proportionally decreases the closer one gets to the poles along the axis of rotation. There is no functional difference between these habitats and Bernal spheres. Only the construction method is different.

Most residents of spun Cole bubbles are in the central third of the sphere where gravity variation is the least. The remaining two-thirds are evenly divided into park and agricultural space and windows near the poles for mirrors to reflect in ambient light. Some enterprising developers have figured out how to control the deposition process such that the bubble is shaped more like a lozenge, thus increasing the internal area spun to the desired speed. The deposition rate is kept the same along the oblong substrate by using nanomachine swarms to induce and control a gradient in the catalyst concentrations in the CO gas.

Because Cole bubbles are fashioned from large metallic asteroids, they are predominately found in the Belt (the icy asteroids found elsewhere being unusable). Cole bubbles can be quite large, easily over 10 kilometers in diameter, and so are capable of supporting hundreds of thousands or even several million people. Spaceports are located at the bubble's axis points, taking advantage of the zero g there.

Domes

Inflatable domes are an exceptionally common habitat used on asteroids, moons, and planetary bodies. They are ideal for being lightweight and

portable as well as quick and easy to assemble (many assemble themselves). They range from small encampment models to ones large enough to contain a massive city. Most are simply composed of plastic films supported entirely by the internal air pressure, sometimes contained with a high-tensile strength restraint net. Strong enough to withstand hurricane winds, micrometeorite strikes, and heavy snow or dirt loads, they are buttressed with hardened shutters in dangerous environments. Some are transparent, some opaque with reflective surfaces. Larger city domes are constructed from sturdier materials like aerogel, transparent alumina, and diamond.

Domes for temporary settlements are simply inflated on any available flat surface. For more permanent installations, they are used to cap off craters, canyons, or shallow holes dug in easily removable regolith. Though the atmosphere on large domes helps protect against radiation, smaller ones are buried for protection. Domes are often protected with multiple insulating layers and damage-sensing autorepair networks.

Under the dome, the settlement consists of whatever structures the residents desire. In smaller domes in airless environments, tin can habs and underground warrens are used to protect against solar radiation and cosmic rays. The larger domes of Martian cities cover massive skyscrapers and urban cityscapes. Multiple domes are often joined together to cover larger areas. Airlocks provide access to the outside, while ventilators pipe out unwanted gases from the air plant and life support machinery.

Planetary domed habitats vary a great deal in terms of security arrangements. The big Martian cities like Valles-New Shanghai and Elysium have fairly relaxed customs arrangements, with anyone able to enter with only a cursory ID scan. Large Lunar and Titanian cities are also very easy to enter, at least for citizens of their respective polities. Smaller settlements vary a lot. Farm towns like Pilsener City on Mars have almost non-existent security, while high security corporate domes like New Dazhai on Mars will subject visitors to full-on customs procedures.

Breaching dome walls varies in difficulty based on the age of the dome and the level of security present. Newer domes usually have smart hull repair and are heavily monitored for atmospheric breaches, while older settlements tend to lack both the fancy hardware and the tight security. Domes also don't offer as many service hatches and drone bays for clandestine access, as domes do not generally have the busy fleets of harvester and repair drones that accompany space habs. Some domes are accessible via underground tunnel networks with remote access points. Domes have a vulnerability in that a significant amount of damage to their structure can create an irreparable breach or breaches, possibly strong enough to vent the atmosphere in seconds.

O'Neill Cylinders

The O'Neill cylinder is named after an American physicist and space scientist who sought to engage his students by getting them to think about big problems—space settlement, in particular. He also led symposiums where the concepts behind large, permanent space habitats—including the cylinder that bears his name—were hashed out.

The basic principle is fairly simple. Construct a cylinder at least half a kilometer in diameter so that it can be rotated at low speed and provide 1 g of artificial gravity all along the interior wall. Vary the length to the intended population size, up to thirty-five kilometers. Divide that wall into six equal segments, three of which are gigantic windows. Cap both ends to enclose the volume. Install three large mirrors to reflect natural sunlight through the windows, as needed. Pressurize the interior to one atmosphere and outfit the three habitable walls as you see fit.

Unfortunately, the resources, on-orbit manufacturing techniques, and low-cost access to space required to complete such an ambitious mega-engineering project did not come until long after Prof. O'Neill's death. To his credit, the O'Neill habitat remains the most iconic symbol of transhumanity's colonization of space and is only now being superseded by such advances as the Hamilton cylinder and bioengineered habitats. There is absolutely no mistaking an O'Neill cylinder.

Those that follow the original specifications are divided into three districts: high-density residential, industrial and commercial, and parks and agriculture. O'Neill colonies are intended to grow their own food, clean their own air, provide local opportunities for recreation, and perform work of value in a space economy. The immense structures are fabricated from metals and composites mined from asteroids, though some of the first colonies at the Earth-Luna Lagrange points made use of lunar materials. Many increase their internal surface area by forgoing the long window sections and providing lighting through end-cap mirrors, suntubes, or artificial means.

Some habitats solve the problem of keeping their mirrors pointed at the sun by connecting two counter-rotating cylinders and using the system as a momentum wheel. A slight imbalance in the counter-rotation is enough to induce a precession in the habitat's orbit and keep the sunward ends pointed that direction continuously, with no propulsion required. This has the added benefit of doubling a given habitat's living area. Single-cylinder habitats use a variety of attitude control measures, including tethered counterweights and electric thrusters.

From a security operations standpoint, O'Neill cylinders have similar considerations as Bernal spheres and Cole bubbles, with the exception that interior surface gravity does not change (except on the end caps). O'Neill cylinders are usually much larger, with significantly more landscape and airspace,

SOLARCHIVE SEARCH: MCKENDREE CYLINDER

Before the Fall, there was talk of building a McKendree cylinder from long-chain carbon nanotubes. This habitat would dwarf even the most massive O'Neill cylinders at a diameter of 920 kilometers and a length of 4,600 kilometers. Even with three windows running the entire length, the habitable surface area would be comparable to the nation of Russia. With the pressure to provide more physical bodies and living space for infugees, some outer system groups are considering resurrecting the McKendree cylinder on a much smaller scale. ♣

making internal operations quite similar to standard ground-based operations.

REAGAN CYLINDERS

The Jovian Republic has focused on what they proudly call the Reagan cylinder (and the rest of the solar system derisively dubs "sarcophagus" habs) as an alternative. Rather than fabricate a pressure shell from scratch, the Jovians capture an asteroid or moonlet and put it in a parking orbit. Miners then dig out a cavern of cylindrical shape and use the slag as ballast to stabilize the spin generated for artificial gravity.

From an engineering perspective, this is actually a clever idea. The thick rock, metal, or composite walls provide highly effective radiation protection and armor against outside attack. Excavating a chamber and sealing it is arguably easier, as well. The problem is that Jovian investment in environmental systems is minimal and their suspicion of nanotechnology and biosystems precludes use of advanced life support that would make the Reagan cylinders a pleasant place to live. Only the Junta's elite on Solano are usually free of the pollution and sepsis that plagues the other Jovian colonies. *Usually*.

TIN CAN HABITATS

Tin can habitats most often consist of small modules connected either directly to each other or by node modules with common attachment mechanisms. These are bare-bones structures with little more than an exterior debris shield, a pressure shell, minimal radiation protection, plumbing for environmental systems, and wiring for electrical and power systems. Unpressurized sections are connected by an open truss or structural spars that can only be accessed by EVA, robot, or telepresence. Unlike cluster habitat modules, even the most basic functions must be provided by internal racks and attached equipment rather than being built in. This simplicity has its advantages for people who want to live "off the grid," especially those wary of the modern panopticon.

Many so-called "tin can" habitats are actually inflatable structures made of a flexible composite pressure shell and a solid central core to distribute loads and stresses. Held rigid by the internal air pressure, inflatables provide more usable volume for the same mass than metal structures and offer superior radiation protection. When radiation hits metal, backscatter radiation can be generated such that there is actually higher exposure on the inside of the pressure vessel than outside. The high hydrogen content of the composites allows an inflatable module to absorb or deflect more radiation without creating backscatter. By lining the interior wall with the station's water tanks, the only significant threat over the long term comes from galactic cosmic ray exposure.

Repairing an inflatable module is much more difficult without nanomachines than damage to a metallic hull. Multiple layers interlock on an inflatable to provide structural strength, debris protection, atmospheric containment, and moisture protection. Breaches must be repaired by weaving in the permanent patch from the innermost layer out, as opposed to the relatively simple welding of alloys. Much as submarines have an inner pressure shell and an outer hydrodynamic skin, many tin can habitats—especially those controlled by military or security interests—will have a depressurized outer armor made of replaceable segments or blocks that does not carry any structural loads. Its only purpose is to protect the pressure shell beneath from debris or attack.

Though tin can habitats free-floating in space are entirely in microgravity, some can actually generate artificial gravity by spinning one or more modules on a tether or structural ring. This is cheaper and quicker than building a torus habitat, though not as efficient over the long term. The centrifugal force that approximates gravity is felt in the outward radial direction, so internal decks are arranged accordingly. The Jovian Republic has built many a "poor man's torus" to try to alleviate crowding on the Reagan cylinders.

Unless transmitted by egocasting, the only access to a tin can is by airlock or docking with a transfer vehicle. In fact, some tin can habitats are actually a series of crew and cargo transfer vehicles with common adapters permanently docked together and kept on station. Most tin cans are simply far too small to have pressurized landing and cargo bays.

TORUSES

Torus habitats can best be described as resembling wheels spinning out in space. They are intended to provide artificial gravity for the entire population through centripetal force without requiring as many resources as an O'Neill cylinder or similar megaproject.

A free-spinning torus will often have a circular cross-section to maximize radiation deflection and best carry the pressure loads from the internal atmosphere. Hybrid habitats where the torus is part of a larger overall structure tend to have a rectangular cross-section for ease of manufacturing and increased overall volumetric efficiency. Even then, the edges where the faces of the torus meet tend to be rounded to prevent stress fractures from the internal pressure.

Docking with the rotating ring of a torus presents a difficult orbital mechanics problem, to put it lightly, so most torus habs locate their docking modules or spaceports at the center of rotation. Spoke arms connect this core or hub out to the ring. If the core is not de-spun from the ring, any visiting vehicle must match the station's rate of rotation about the approach axis to dock. This is not as much of an issue for large torus habitats with a slow rate of rotation.

The radius of any spin habitat is proportionally related to the decimal fraction of Earth-normal gravity desired and the inverse-square of the radial velocity. This means that the most significant limitation is the rate of rotation the inhabitants can withstand without Coriolis effects on the neurovestibular system causing discomfort and nausea. In baseline humans, the maximum safe speed is about two revolutions per minute. Beyond that, an increasing proportion of the population experiences nausea, some of whom never recover.

The smallest 1 g torus habitats are, thus, nearly 500 meters in diameter across the axis of rotation, while a 0.1 g torus can be as small as 50 meters. Many torus habs associated with the Planetary Consortium approximate the Martian standard of 0.38 g to reduce the minimum size of the station while still providing an environment amenable to many, if not most, biomorphs.

"Double-decker" torus habitats actually consist of two counter-rotating torus sections around a de-spun core section. This allows the two sections to cancel out each other's momentum on the core without the complicated machinery required of single section habs. However, moving between each section does require temporary exposure to microgravity during the portion of the trip moving through the core.

The majority of torus habs have a common environment through the entire structure. Industrial and commercial outposts tend towards a more functional layout that takes up the entire interior like decks on a ship, while colonies have an open air volume and exterior windows along the core-facing side and an artificial biosphere resembling a valley that wraps back around on itself. In the classic Stanford torus layout, a system of reconfigurable mirrors provides a day-night cycle through the windows. However, some stations accommodate multiple environments by partitioning the ring or adopting the double- (or even quadruple-) decker configuration.

Exotic and Variant Habitat Types

Transhumanity and its varied exotic interests and morphologies have a habit of inventing interesting new ways of carving out a home. Some of the habitats below are uncommon now, but they may be more common in transhumanity's future.

Biological Habitats

The success and attention given to the Hamilton cylinders and more artistic station designs such as MeatHab has sparked a number of new projects to design and grow habitats with a biological (infra) structure. One group of nano-ecologists is attempting to grow the first "Dyson tree" on an apohele asteroid; they have already grown a substantial forest of intertwined roots and trunks, each sustaining a breathable atmosphere and living ecosystem inside. A neo-octopi art collective in the Belt is almost finished with their modified Bernal sphere design that is in fact a massive neogenetic organism adapted from jellyfish genetics. This small station is intended to be microgravity, with an aquatic interior. Another group recently completed their proof-of-concept of a cluster hab grown from modified "space coral." Most of these biological habitats are small in size and scope, housing hundreds at most, usually only dozens. As their success continues, we are likely to see more interesting and unique designs.

Carousel

The carousel is a new design now under construction. Also known as a beaded torus, this habitat is constructed from domes that are chained together in a circle shape around a central hub. An array of support spokes, some containing elevators, connects the domes to the hub, which is a non-rotating spaceport. The domes have a flat base (the rim of the wheel), with the top pointing towards the hub. Spin gravity and landscaping provide a natural-seeming environment for the dome interiors, while mirrors around the hub focus sunlight. Each dome has its own life support systems, meaning that if one fails the residents can still escape to another. The first carousel, Infinite Loop in the Saturnian Trojans, already has two functioning domes, with four more planned.

Disc Habitats

Disc habitats are an uncommon design. They are essentially flat enclosed discs, spun for gravity, like a filled-in torus or a slice of an O'Neill cylinder. The best known, Mahogany in the Uranian system, is somewhat atypical in that it has an axial light source and spaceport facilities along its rim. Most discs have a light source running in a ring around the rim, allowing for an axial spaceport, or, if they're close to the sun, windows. Discs are otherwise similar to toruses and O'Neill cylinders in terms of their systems.

SPACECRAFT HABITATS AND SWARMS

Many spacecraft essentially function as permanent or semipermanent habitats. This is particularly true of large, long haul spacecraft, which are in essence mobile tin can habitats, and nomadic swarms that serve as mobile colonies. In fact, many tin can habs and swarm modules are built from repurposed bulk freighters or other large craft. The primary difference is that all but the largest spacecraft are not designed for sustainability the way habitats are. Spacecraft typically lack the fleets of robotic harvesters and large, internal green spaces that make habs self sufficient. A spacecraft's job is to move from point A to point B. Refurbishment, resupply, and harvesting or purchase of raw materials then happens at point B.

From a security perspective, spacecraft colonies are just like many other stations, except they're mobile. Most are microgravity environments, with a few maintaining small toruses with light gravity. Accessing, securing, and otherwise manipulating these environments is thus quite similar to defending or infiltrating a cluster, tin can, or torus habitat. ■

HAMILTON CYLINDERS

At first glance, the three Hamilton cylinders in the Saturnian and Uranian systems do not appear much different externally from an O'Neill cylinder. Both are based on the premise of providing a large pressurized volume and a wide surface area with artificial gravity provided by rotation. However, the O'Neill cylinder is largely a fixed construct upon completion. Applying nanotechnology on a broad scale, the Hamilton cylinder is intended to actually grow with its population over time.

The exterior shell of a Hamilton habitat is a silicate polymer composite structure that both forms the vacuum seal and provides the structural skeleton for the habitat. A middle layer of nanofabricators and bioreactors absorbs waste from the interior biosphere and combines it with material collected by the resource harvesters. This is used to replenish the outer shell, replace the habitat's nanomachines, and sustain the water, nitrogen, and carbon cycles present inside.

Past a permeable insulation layer is the "neural strata"—a widely distributed nanocomputer network governed by neural networking algorithms and adaptive learning protocols. This system is the "brain" of the Hamilton cylinder and controls the entire process, automatically adjusting the habitat's ecology, size, and functions according to the needs of its inhabitants. As nanoprocessors fail, they automatically fall out of the system for recycling and replacement. Also, this means there is no single point of failure for the control system, as every piece contains the algorithmic map of the whole. Mesh access nodes provide an interface between the neural strata and the more conventional information systems available to residents.

The biosphere layer consists of organic soil material that provides a habitable surface at Earth normal gravity, while the remainder of the interior is pressurized at one atmosphere. Solar tubes mounted on a central spar along the rotational axis provide a day-night cycle by electrochemiluminescence. This allows the use of the entire cylinder wall area for habitation. Power is provided by fusion reactors using locally sourced deuterium and tritium.

The initial construction and development phases required almost constant resource harvesting of ice and silicates from the rings of Saturn and Uranus and captured asteroids, as well as complex organic materials from Titan. However, the environment on the completed Hamilton cylinders is as close to an entirely closed-loop system as transhumanity has yet devised. Most of the resource harvesting in the present day is for fueling the fusion reactors and the personal activities of the cylinders' residents. There is some talk that the next generation of Hamilton cylinder could be suitable for use as a space ark to explore extrasolar systems via sub-light travel.

MATRIOSHKA SPHERE

Matrioshkas are a new and unproven design, still deemed an experiment by old hands at habitat ops. Matrioshkas feature a large central reactor surrounded by concentric spheres of decks, each run in part by waste heat from the systems of the inner spheres. Beyond this novel energy distribution model, matrioshkas are otherwise similar to cluster habs, except with the modules stacked on top of each other like the decks of a ship. Two types of Matrioshkas have been tried; one spun for gravity, like a layered Bernal sphere, and another maintained as a microgravity environment.

PROCESSOR LOCUS

Processor habitats are essentially floating computers in space. They are not intended for habitation by biological life, instead populated entirely by AGIs and infomorphs. Processor habs have the usual cloud of support structures that accompany most habitats: drones, refineries, factories, defense satellites, and so on. The actual habitat units consist of one or more massively shielded processor blocks. These form a mesh in which a large number of minds can run, often in a simulspace.

The environments inside of a processor hab vary a great deal. Some offer simulspaces that are relatively comfortable for transhuman-born infomorphs, where humanoid or animal-like avatars can interact in a world that provides an illusion of physicality. Others are surreal and disorienting, with simple simulspaces consisting entirely of interactions between geometric shapes ranging in complexity from basic polyhedrons to wild fractal clouds. In a habitat called the Flea Circus, one of the processor modules actually contains a miniature city in a cavity only a few meters wide, yet appearing as a vast metropolis relative to the nanoscale robotic avatars used by the populace for social interaction.

Processor habitats fall outside the realm of operatives in our line of business. Security and infiltration concerns are almost exclusively relevant to electronic intrusion experts.

THE SPACE LIFE SURVIVAL GUIDE

Posted by: Coots, Firewall Proxy <Info Msg Rep>

This guide is for those of you just re-instantiated and still acclimating to offworld living. It represents the accumulated knowledge of each of us that's fucked something up or seen things get fucked up and added their experience to the collective. It's been sanitized for op-sec so we can share it without burning anyone, of course, but everything you learn here could be useful to you someday—maybe even today. If you take anything away from this, it's to always check your assumptions. Even the basic things can trip you up big time if you neglect them.

FINDING UP

Phrases like "things are looking up" and "look at the upside" once meant something like "consider the good in the situation," but they went through an ironic shift in the solar system's early space-colonial culture, mutating in the microgravity of early tin-can stations to mean a variety of practically sarcastic sentiments, typically something like "be careful" or "let's be realistic." The joke (that is, that there is no "upside") wore off in a hurry, but use it with some original space colonists or old-school veteran habtechs and you might break some ice. Try it sarcastically as a harmless bit of jargon ("look up, at least we'll die quickly") or transform it a little ("that bastard's always looking up") to fold yourself into a habtech conversation.

Directionality depends entirely on your frame of reference. In microgravity, everything is pretty much arbitrary, especially in interplanetary space. The first space stations in orbit around Earth used a coordinate system based on the nadir-zenith axis. Nadir pointed to the Earth, while Zenith pointed out into space. The plane perpendicular to this axis was used to define "port," "starboard," "forward," and "aft." Internally, up and down were called "overhead" and "deck" and corresponded to zenith and nadir, respectively.

Current cluster and beehive colonies are much more complicated in geometry than those early tin cans, so most adopt a local x-y-z coordinate axis at the volumetric center and indicate location on a three-dimensional frame. For example, it is common to define a series of levels (the z axis) and a two-dimensional coordinate grid (the x and y axes) on each level. Within an enclosed volume, "overhead" is in the direction of

the "top" level and "deck" is in the direction of the "bottom" level.

Spin-generated artificial gravity can add an entirely new dimension of complexity to this problem, as points on the internal volume rotate with respect to a fixed observer on the outside. To simplify matters, most stations adopt a locally fixed two-dimensional coordinate system akin to latitude and longitude within the rotating volume. Large habitats, like O'Neill cylinders and Bernal spheres, typically assign an arbitrary North and South aligned with the axis of rotation, with East and West divided up accordingly. "Sub-surface" levels within the rotating structure are treated as if they were on Earth. Some are better organized than others.

Torus stations commonly lay out the volume as if it were "unwrapped" on a planetary surface, with "overhead" pointed towards the rotation axis and "deck" away from the rotation axis. Internally, torus stations function not unlike submarines or subterranean bunkers, depending on how the internal volume is utilized.

For external observers, such as repair crews, a grid coordinate system fixed to the non-rotating structural frame is typically used. For operations involving the exterior of the rotating volume, the direction of rotation is referred to as "spinward" and "anti-spinward" is the opposite. Some torus stations also use the terms "spinward" and "anti-spinward" because they are convenient for their layout.

If any of this is confusing to your flatlander sensibilities, don't worry, you'll pick it up quickly. Your muse can handle your direction-finding and coordinate-mapping anyway, and most stations provide helpful e-tags and AR guides for visitors.

Gravity Transition Zones

The closer you get to the rotation axis, the less simulated gravity there is. Once you get to the very center of the volume, you're back in micro-g. It's as simple as that. This can screw with your head, though, if you're not adapted or properly trained for it. The important thing is to understand what kind of situation you've got, prepare yourself for it mentally, and—pardon the pun—roll with it.

Most large volume habitats have trams or moving rails that control your rate of "descent" into artificial gravity and help keep you from getting motion sickness. If you're coming from a counter-spun section that is fixed in microgravity, the "hub" is close to the axis of rotation, so it's just a matter of floating to the exchange station and grabbing a handhold or rail when it passes by. The rate of rotation is slow enough that most individuals shouldn't have a problem. If the entire structure rotates with the habitat, the hard work is done for you.

No matter what, be careful about pushing off the walls and getting stuck floating in the internal atmosphere with no easy way back. Well-managed stations will have someone to come help you, or the natural air flow may eventually push you within reach of something, but there's not always a guarantee. Rumor has it that a drunk spacer only managed to rescue himself from such a predicament by using his own piss as a propellant.

A centrifuge on a spaceship or a small torus habitat, on the other hand, will require that you traverse a ladder or ride an elevator in the radial direction. The whole structure is moving, so you don't really have any other options. Unless it's an emergency, move at your own pace. Go too fast and you'll make yourself sick as the gravity gradient increases (or vice versa).

Moving in Microgravity

The baseline human body is derived from millions of years of evolution in Earth gravity. Bipedal locomotion gave us the balance of speed, agility, and the ability to look over obstacles that allowed our species to rise to dominance. In microgravity, those advantages are essentially negated. Moving about requires you to change the way you think and train your body to react accordingly. At least we still have that advantage—the adaptability of the transhuman mind.

Newton's Law reigns supreme up here. For every action, there is an equal and opposite reaction. In terms of physics, motion in microgravity is fairly simple. You decide where you want to go, determine the optimal route, and apply the necessary forces in the correct vectors to arrive at your location. Learning to do all that in your head without thinking about it is the hard part.

If you want to get somewhere fast, push off the opposite wall as hard as you can with your arms or legs. Be careful, though, because you'll have to cancel out that energy at your destination, either through absorbing the impact without rebouncing or a capture device like a rail, handhold, or grapple. You could always make it easy for yourself and obtain personal cold gas jets for reaction control, but true veterans think those are for children, the infirm, or the hopelessly eccentric.

Assuming time is not an issue, the best advice is to take it steady and take it slow. Most habitats in microgravity are adorned on their interiors with rails, handholds, grapple fixtures, and fabric fasteners (like velcro or grip pads). You can use these to traverse the interior with a measure of stability and control while you get your bearings. It is not uncommon for habitats to color code these items as a matter of traffic control and to help maintain orientation. Morphs in a hurry can fly through the center of the volume and are assumed to be capable of navigating themselves.

Use your legs for power and your arms for control and course correction to get the best efficiency out of your body. If you happen to be in a bouncer morph or have prehensile feet mods, you get the best of both. And if you think bouncers and neo-hominids are wiz for micrograv, try out an octomorph sometime.

Once you feel like you know what you're doing and any feelings of space motion sickness are gone, find a quiet spot with a minimum of protrusions to practice free-flying. Learn how much force you need to apply to move your body and still be able to control your stop. Do this over and over again until it becomes muscle memory. If you need it in an emergency, you won't have time to think about it. Also, take some time to learn how to recover from a free space—an open volume where you can't grab or push off something. The first time you try this, you're likely to panic and flail about to no avail. As dumb as you're going to feel afterwards, that's your mammalian, 1-g brain reacting naturally to a new situation. Experience that for the first time when your survival doesn't depend on it. Once you've calmed down, start using physics to help yourself. If you are in a spin or tumble, extend your arms and legs all the way out. Conservation of momentum will slow you down. Atmospheric drag will begin to slow you down, too. Once you locate the nearest surface or object you can safely grapple, slowly point your body in that direction and do the breaststroke. Use your arms only and be careful to bring your hands back up along your body to reduce any counter-motion. It's neither pretty nor efficient, but it will get you there if you don't overexert yourself or help doesn't reach you first. If the air is circulating, release a small object to locate the prevailing currents and use them to your benefit. Every little bit can help in this kind of situation.

Up to this point, we've assumed that you're inside a pressurized volume. In vacuum, your options are even more limited. Without reaction mass or something to push off, you aren't moving. End of story. Safety tethers and emergency gas jet packs with just enough fuel to recover you from a spin and push you back towards your habitat are standard fare, even if you're traversing in nothing but a soft suit. This is intended to provide you with a proverbial safety net (though some habitats have been known to deploy the real thing) for a minimum amount of mass penalty.

Just remember: it's all about inertia.

Donning a Spacesuit

You've seen the public-service videos and you've heard the habitat orientation spiel, but it's worth the refresher. You need to know how to don a spacesuit.

A trainer in Mars orbit used to harangue us with this bit: "We don't hurry up and put on our spacesuits as fast as we can so that we don't die," he'd say. "We don our suits. It's faster."

The lesson there is a good one: Get the thing on right and simple. Do it right and you'll be safe. Do it simple and you'll be quick. Anything else risks adding unnecessary bullshit to the proceedings. When you need a spacesuit, you want a minimum of bullshit between you and wearing that suit properly.

You want to sound like a spacewalker? You want habtechs and cosmonauts to think you know the ropes? Use that word, *don*. It's jargon to them.

Those simple mnemonics they give to kids about spacesuits are good ones. They work and they're true. "Feet first!" says one. "Bottoms up!" goes another. Good advice, there. Or as that old Martian used to put it, your helmet needs something to attach to, so get all your gear on first. Otherwise you're balancing a helmet with one hand and trying to suit up with the other. Your helmet is your reward for proper procedure. Short cuts lead to slow leaks.

Most of the non-combat damage done to spacesuits consists of tiny holes or tears. What do you do if the microhabitat of your spacesuit gets one of these tiny tears? If you've got it, you apply a putty seal straight from the tube. If you don't, you press down on the tear until your own skin is plugging the hole. If you're bleeding, coagulating blood is nice and sticky, so let it help seal the tear. The skin that's exposed to vacuum will hurt like a bitch later, but that is one small price to pay and one giant save for your suit's resources and your life.

If your spacesuit suffers more catastrophic damage, your number-one concern is containment. A good suit allows you to compartmentalize—sealing off an exposed limb, for example—for the sake of your suit's life-support systems and your overall survival. If your suit can't or won't compartmentalize, then it's time to talk about handling decompression and exposure to the vacuum of space.

A lot of spacers swear by smart vacsuits—and for good reason. The obvious advantage is that you don't have to change your kit when you need to take an EVA—you just trigger the smart fabric and whatever outfit you're wearing transforms into a vacsuit. This is especially useful in emergencies. Where it really shines, though, is when something happens that knocks you unconscious. You can set your muse or the smart fabric itself to automatically switch into vacsuit mode if there's ever a loss or contamination of atmosphere. They call that feature "survival for dummies."

More than knowing how to don a suit, having an inkling of where you can find the nearest suit is even more important. Your muse and/or the habitat's safety subsystems can point you towards the nearest suits in a fix, but what if you're stuck in an unfamiliar station that just suffered an environmental failure? The place to look is by the exits. Just about any airlock is going to have a vacsuit closet nearby, and these almost always have emergency access features, even if they're normally locked and restricted away. Vacsuits used to be tailored to the individual and it was bad form—not to mention kinda gross—to use someone else's, but these days most suits will mold to fit your body shape and the cleaning systems are good enough that it's kosher to share. When all else fails, vacsuits tend to be a standard blueprint that comes with almost any fabber for safety reasons, so you can probably print one up if you need to—hopefully you'll have enough air to wait it out.

How to Handle Decompression

Your spacesuit has snagged and torn on the shrapnel inside a derelict habitat. Some lunatic's explosive device has breached the hull of your spaceship and you've tumbled out into space. You've been put in an airlock by people who want you dead and soon you'll be ejected into the black nothing between the stars.

Here's what you do.

Above all, do not hold your breath. The gases in your body expand as they decompress, and if you trap air in your lungs, the soft tissues just tear or rupture as the gases push out against them. Blood vessels in the lungs may burst. Even morphs built with tough lungs are likely to find that holding a breath is more painful and no more useful than letting that breath go, so exhale as you decompress. You want your airway to be open so your lungs can vent. Remember that.

Now that you're doing the right thing with your lungs, let's be clear about what decompression is. The dangers of decompression in space are separate from the dangers of exposure to vacuum—separate them in your mind. Decompression is dangerous whether the vacuum of space gets involved or not.

In a "normal" environment, your body operates under the weight of atmosphere pressing down on it. Decompression is a change in the weight pressing down on you. Like releasing your grip on a wad of paper or a plastic bag half-full with water, when the pressure on a morph is released, the morph expands. As internal gases expand, most morphs swell and bloat. This usually looks worse than it is.

The most common form of decompression you're likely to worry about is the change from roughly one atmosphere—the standard mix of gases that make up a typical habitat's air, based on old Earth norms—to no atmosphere; the transition from a habitat to open space, in other words. Decompression is also what happens, though, when a diver comes up from underwater. The weight of water and the atmosphere above that water compresses the morph, and deeper dives mean more water and more weight pressing down. A diver coming up from under the Europan ice might have to decompress from multiple atmospheres' worth of weight, while a spacewalker in an accident only decompresses from one atmosphere to zero. The trick is to decompress slowly for safety. This is why divers come up at a measured rate, to transition through multiple atmospheres worth of pressure gradually.

The risk of decompression sickness—or DCS, what we used to call "the bends"—is that expanding gases will shift around inside your guts. Your gastrointestinal tract expands, your organs get shifted around, your nerves get pressed on. It feels lousy, but in a sturdy body the risks are manageable.

The big risk isn't decompression, but rapid or "explosive" decompression, caused by moving too quickly from one volume of pressure to another. Like, for example, being blown out into space. The sudden expansion of gases in a decompressing morph puts strain on organs and internal systems, causing those soft-tissue tears and possibly shifting guts around in a way that can make it hard to breathe or swallow. Gases can get from the leaking lungs into the delicate blood vessels in the pulmonary tissue and end up as air bubbles in the heart or brain, which can kill even a healthy body.

Explosive decompression doesn't end in a gory whole-body explosion, like you see in vids, but it's bad. Even in a rugged morph, decompression can cause deep internal damage that's expensive or impossible to repair.

Something to else to worry about during explosive decompression: the explosive part. Debris is flying, possibly cutting or piercing you. Fog may form as gases under different pressures and temperatures collide, blinding you. Those gases slamming into each other can roar, deafening you. You'll probably be screaming, which at least means you're not holding your breath.

The only things you can do during explosive decompression to minimize the damage are exhale slowly, keep your calm, and be lucky. Where your diaphragm is pushed to by expanding gases is really out of your control.

Properly handling decompression is only part of the space-inhabitant's nightmare scenario, though. If you survive the sudden decompression from one atmosphere, you still have the problem of surviving the lack of any atmosphere at all.

How to Survive in Vacuum

Contrary to the sort of popular rumors that still circulate among the citizens of large and posh stations, where it's actually possible to be so far removed from the dangers of the vacuum just outside the sky, the vacuum of space doesn't equal the instant death of a fragile biomorph. In some places, habitats are so stable and safe that whole swaths of the population don't know anyone who has had first- or second-hand contact with the vacuum of space. In other stations, superstition and fear simply trump the safety videos and emergency procedures that are normally ubiquitous in modern existence.

You need to be better informed than those people. You need to know what happens (and what to do) if your morph gets dumped into the empty void.

First, let's dispel some rumors. Vacuum doesn't boil your blood or freeze your flesh. The decompression to zero atmospheres doesn't make your body explode—skin is simply tougher than that. The dangers of vacuum are serious but they're not so grotesque.

Vacuum doesn't have a temperature of its own, so space is not really that cold. It's a great insulator too, meaning that your core body heat doesn't get sucked away. Without an atmosphere to transfer heat away, the risk of exposure is somewhat mitigated.

The saliva on your tongue may boil off, as it's not pressurized like your blood is, and you may get some frost on your skin. Sunburn from direct contact with the sun's ultraviolet rays is a more immediate danger than perishing from cold. You'll suffocate long before you freeze.

Your body is swelling during all this, too, pinching nerves and aching like hell, so don't count on a lot of manual dexterity. If your plan for surviving an unpressurized spacewalk involves working a zipper or most portable electronics, you may be fucked. This is another reason why outer-hull control surfaces tend towards large, highly visible buttons.

The most important survival tip for vacuum exposure is *not* to hold your breath. With no external air pressure, the alveoli holding oxygen in your lungs will burst. This will hurt and may damage your ability to breathe should you get back to an atmosphere. So the very first thing you should do is exhale completely and get those gases out of your body. Realistically, rapid decompression is almost more dangerous than vacuum exposure. You may not have enough time to exhale in a sudden blowout, meaning that your lungs and eardrums may burst, your sinuses and soft tissue areas may be ruptured, and you're more likely to succumb to hypoxia more quickly.

After your body has pumped the last of its oxygenated blood to your brain, you'll lose consciousness. With the stress of shock and hypoxia that your body is going through, you'll have only a limited amount of time before you pass out. For flats, this can be as short as 15 seconds. Morphs with basic biomods can retain consciousness for a minute or more. After you lose consciousness, you've got maybe another minute or two in a typical morph before you're well and truly dying.

The trick, then, to surviving exposure to vacuum is to be rescued. That sounds foolish, but it is vital—plan for rescue. If exposure to vacuum is a foregone conclusion, do what you can to avoid being blown free of the craft or station. You want to be somewhere reachable and not drifting away from rescuers at the speed of a blowout. Call for help and keep transmitting so they can triangulate your location from your signal if need be. Curl up into a fetal position, especially if you're bouncing around among a cloud of debris. Even if you die, your muse can still help others find your body and recover your stack.

Recovery from vacuum exposure can be quick—some rescued subjects spontaneously resume breathing when exposed to atmosphere—with few or no long-lasting side-effects, as long as you minimize lung damage during decompression and are rescued before suffering brain damage from massive oxygen deprivation. If you're lucky, you'll pass out in space and wake up in some medical bay somewhere. If not, well you'll hopefully still wake up in a medical bay, just sleeved in a new morph after they recovered your stack. If they didn't get your stack, well, you had a backup, right?

LIVING SPACE IN SPACE

Source: Orientation Class for Re-instantiated Egos, Titanian Commonwealth [Link]

Even in the dome habitats on Mars and the settled moons of the solar system, living space comes at a premium. Every cubic centimeter that requires environmental control and life support processing is an expense in energy and resources. Though conditions vary widely, this is an inescapable fact. With the backlog in infomorphs after the Fall, every settlement, station, and colony is trying to fit as many people in as small a space as possible. Some, of course, do this more comfortably than others.

SMALLER AND MICROGRAVITY HABITATS

Cluster and micrograv tin can habitats have the benefit of a virtually unlimited internal arrangement. Unfortunately, they are the most limited in internal volume and often comprised of relatively small modules. A standard dedicated habitation module comfortably holds individual cabins for up to 40 humanoid morphs. Each cabin typically has a sleeping sack, storage locker, and in some cases an ecto. This number can be doubled if cabins are eschewed in favor of open sleeping racks.

There is no amount of usable area or volume that goes to waste in a tin can or cluster habitat because there simply isn't any to spare. A central volume is reserved for transit and kept clear of protrusions, but the module working spaces are filled with cargo lockers, removable and repairable systems racks, mesh node hardware, spacesuit lockers, laboratory modules, and everything else essential to the operations of the station.

The first permanent space stations actually found storage and logistics to be one of the hardest problems to solve. Keeping track of every package of bolts, every tool, every syringe, and every canister across multiple years and multiple crew rotations was almost impossible until mesh tracking became a possibility. Most items are automatically tagged with a spime and e-tag and then logged with logistics control software so that anyone who has access can look up what they need, precisely locate where it is, and even keep track of how often it has been used. This is important for consumable items that need to be replenished over time.

LARGER SPIN-GRAVITY HABITATS

As the habitats get larger and spun for gravity, more room is available. Much of this extra space is used for open air and sculpted "natural" environments, as well as large urban areas. The population density of cities is comparable to any megacity on Earth before the Fall.

On a torus or cylinder habitat, most people will have a small apartment indistinguishable from those planetside, except for the noticeable wall curvature on the smaller stations or those fortunate enough to have a window looking out to space. A bed, washroom, kitchenette, folding desk, in-wall drawers, and a small closet are standard accommodations. The widespread availability of augmented reality features, virtually inexhaustible data storage in the cloud, and simulspace access tends to reduce the need for large media storage and appliances. Instead, many people choose to personalize their residences through unique arrangements of the internal architecture, AR enhancements, artwork designed to showcase the person's personal style, and individual pieces of furniture. This has proven to be a popular cultural practice, regardless of a habitat's dominant political philosophy, because it encourages resident commitment to their home and measurably improves morale.

SYNTHMORPH-ONLY AREAS

These are not the only options available. Though synthmorphs are considered socially uncouth in some circles and outright discriminated against in others, they have the ability to reside in areas completely uninhabitable by biomorphs—including hard vacuum. The biggest danger for these individuals is radiation exposure, so habitats that cater to synthmorphs typically provide solar storm shelters built from water tanks and composite materials. Hardened mesh access points allow them the same virtual amenities as in the pressurized sections.

LANDSCAPING

Studies from the beginning of spaceflight consistently show the positive psychological benefits of natural sunlight, greenery, and soil. The majority of morphs report decreased environmental and personal stress proportional to the presence of these environmental factors. Sunlight is very easy to come by in the inner system, even for habitats without the massive windows and mirror arrays on torus and cylindrical colonies. Suntubes collect the ambient light, transmit it by fiber-optic cable with virtually no loss, and illuminate the final location directly. These are a popular lighting system on microgravity habitats because they require no additional power and the collectors can be mounted adjacent to solar panels. Concentrators are required, though, as one moves further out in the solar system. Shadow also renders suntubes useless, so LED lights approximating the spectrum of sunlight are just as common.

Plant life and soil are what connect much of transhumanity back to the Earth that was lost. Even most tin can cabins have enough volume and water supply for a resident to grow an aloe or spider plant in a small hydroponics bulb. Free soil is simply too much of a hazard for microgravity habitats, though some have recreational areas designed to resemble a terrestrial location, such as a rock wall with plants growing from the cracks or a rainforest canopy with tree limbs as the only internal structure. Aquatic habitats might

also include kelp forests that grow in the direction of whatever light sources are available.

The presence of artificial gravity (or a planetary settlement) enables environmental designers to perform true landscaping, though. Torus habitats are often arranged to resemble a valley, with terraces on the upcurved side walls and streams and ponds at the bottom of the curve. Cylindrical habs have a tendency for rolling plains with rocky outcroppings at the poles. Because the gravity is the same along any point on the inner wall of a cylinder, the terrain and features—such as farm plots, small lakes, dense woods, wild grass, or, even, desert—can be as varied as resources and the internal area allow.

Overcrowding in hypercorp, Martian, and Jovian habitats minimizes the amount of open land available to those residents, though. These often resemble pre-Fall megacities and suburbs, with the habitable area covered in apartments and buildings that stretch down into the primary structure. Some sarcophagus habs even build right on top of fused rock, with no soil to act as a buffer. Unless residents make the effort to maintain community gardens or press for public parks, there are only token efforts at keeping trees in planters and swathes of genengineered grass designed to filter surface runoff.

Augmented reality and simulspace provide alternatives in these and other circumstances where the positive stimulus is not available by natural means, such as a workers' hab in a permanently shadowed crater. Some morphs prefer to decorate their homes with AR plants and entoptic or holographic environments because they are infinitely customizable and require no actual upkeep, though virtual plant life does not provide the environmental health benefits of the real thing. For these people, seeing is believing… and that's enough. Simulspace environments are indistinguishable in sensation and experience for infomorphs, so this is how many habitat residents and spaceship crews on long tours avoid cabin fever.

Toilets and Hygiene

On average, there are zero-g toilets and a hygiene station for every ten morphs. Everyone has their own molded funnel for the urine vacuum, towels and waterless shampoo for bathing, and saliva-activated toothpaste for oral hygiene. Free-floating water is a hazard for both breathing and electronics, so microgravity habitats find ways to avoid using water unless absolutely necessary. Most tin cans don't actually have showers. It is difficult to safely form a lather in microgravity and even more challenging to rinse, though some systems use fans to direct water flow.

Instead, saunas are popular because they give the sensation of water while being much easier to use. These aren't open rooms with wooden benches, though. A microgravity sauna is a collapsible plastic cylinder with a seal around the user's neck. The "top" ring of plastic is usually transparent so the user can see inside the sauna and operate its small heater. Wet towels can be placed on the heater to form a small amount of steam or wiped on the body to make a cooling effect in the dry, warm air circulating through a fan and out a suction tube near the feet.

Pets and Wildlife

Companionship is another important part of adapting to life in space. Transhumanity didn't just bring uplifted animals to the habitats, we also brought pets and beasts of burden. It is not uncommon for people to choose an anthropomorphized dog, cat, or other small animal for their muse. A real dog or a real cat is often taken as a sign of wealth, though, because it indicates that person can afford to cover the cost of the pet's food, air, and water. The difficulties of their upkeep tend to limit the presence of pets on microgravity habs. No one really wants to clean up the free-floating remains of wet cat food and even smart dogs don't take to suction urinals well.

So-called "fur coats" are popular in habitats with specialized environments that require functional clothing and amongst social groups that adapt the physiological responses of the coats (such as, prickling fur or spines or twitching of ear-like folds) into their exchanges. Their relatively low cost and simplicity make the fur coats attractive to people who cannot afford more extensive mods to their morph, though the derision from morphs who can adapt themselves to resemble the animal of their choice is palpable.

Various smart mammals—particularly dogs, cats, and rats—are common because of the thousands of years of the development of civilization in parallel with these animals. Dogs and cats also have natural senses of smell orders of magnitude more evolved. With very simple bioengineered mods, these animals make excellent and unobtrusive sentries. If there are no cybernetics, the only way to tell the difference from a baseline or feral animal would be to do a genetic scan. Because these pets represent an investment, many owners prevent runaways by including bioware that give the animal a strong affinity for the owner(s) particular pheromones.

Habitats with enough gravity and surface area for parks and open land will often include wildlife with similar mods that prevent them from attacking the residents. For example, roe deer, sheep, goats, and alpaca can serve as natural methods of keeping plant growth under control and can be raised for their fiber and meat. Alpaca textiles are particularly favored amongst those who prefer non-synthetic fibers and the wares of craftsmen because it comes in a variety of natural colors, has excellent thermal properties, and is hypo-allergenic. Alpaca instinctively keep their feeding and waste areas separate and are a hardy breed, originally from the Andes Mountains of South America, so they are becoming increasingly popular.

Beneficial insects are found in agricultural modules and larger habitats with food growth areas. These are commonly genetically modified for easier control and containment. Bees are particularly useful for

pollination, for example, though they are sometimes replaced with pollinator nanoswarms. Ant colonies controlled by pheromones are sometimes used for debris cleaning. Some habitats, particularly older ones or those that had a large influx of physical refugees during the Fall, still have occasional or ongoing issues with vermin and pest control. These often deploy pest control nanoswarms or other insects that excel at eating other bugs.

Some nature park habitats are specifically designed to replicate the original territory of animals in the wild, without accommodations for transhuman civilization. These arks serve a useful purpose in preserving Earth's biological and genetic heritage, but their management practices and styles can vary widely. Some are true research outposts and wildlife refuges dedicated to maintaining the highest scientific and ethical standards of care. On the opposite end are the "entertainment parks" that allow egos to temporarily inhabit an animal's body and do as they please until their time runs out or the animal is destroyed. Habitats that host this kind of bloodsport are frequently targets for uplifted animal-rights groups.

ACTIVITIES

Diversions are how most people deal with the emotional and physiological stress of life in an enclosed space. In rep economies, hobbies and craftwork easily take on lives of their own because they add to the distinctiveness of a particular habitat. While fabbers have made everyday items of almost inconsequential value, the subjective value of wearing an item of clothing or piece of jewelry made by a notable artisan or projecting an entoptic display designed by a well-regarded AR engineer cannot be underestimated. It is the style, design, and effort represented by the product that are valued, more so than the product itself. This is also true in the old economies of the inner system, but to a more limited extent because of the lack of upward mobility.

Sports and physical activities that take advantage of a habitat's characteristics also serve as effective stress relief by both the release of endorphins and the positive mental associations between the habitat and the activity. In microgravity or low-grav habs, wingsuits and microlight aircraft—such as personal ornithopters powered by high-density artificial myomers and pedal-powered propellers—allow personal flight with minimal risk. Some habitats maintain airflow for the environmental control system with the use of strategically placed heaters that generate thermals. Air endurance races challenge the participants to see who can stay aloft the longest by riding the thermals and the currents coming off them.

"Tether jumping" is a dangerous sport that is slowly increasing in participation and viewing amongst microgravity habs. The "jumper" attaches a line to their release point and deliberately fires maneuvering jets up to a velocity such that the kinetic energy of the flight exceeds the tensile strength of the taut cable. The goal of the jumper is to fire retro-jets at the last possible moment to keep the cable from breaking. In competitions, scoring is based on minimizing the duration of the retro burn, coming the closest to the maximum load on the cable, and style points from acrobatics performed during the free flight. The most lucrative competition leagues do this without emergency lines or capture nets. Disqualification by tether break can be fatal if rescue shuttles are unable to catch up.

While cross-country running is an option for cylindrical, torus, and dome habs with open land area, freerunning is the most widespread sport in the solar system because it can literally be done anywhere there is sufficient room to build up speed. Only small tin cans or cluster habs lack the space, though some creative individuals with too much time on their hands have circumvented this problem by developing micro-scale synthmorphs and designing freerunning tracks appropriate for their size.

The largest aerostat on Venus, the Shack, holds an annual freerunning festival that snakes its way through the immense construction platforms and the warrens of the main city. While the freerunning competitions on Octavia and Aphrodite Prime are noted for their pomp and beautiful scenery, the Shack is regarded by enthusiasts as the greatest challenge because of its industrial focus and the real danger of falling. The tourism industries on the other aerostats strongly discourage courses with a real risk of permanent death. Up to two thousand die-hards will show up at the Shack for the festival, without fail. There is no better view of the Venusian skyline, so long as a runner doesn't lose their footing.

Freerunning in O'Neill cylinders allows for a variety of terrain and interweaving paths. The bridges across the windows form natural chokepoints for endurance runs across the districts. Cross-training elements can be introduced on paths through the agricultural districts and parks. There are also triathlons and "summer" biathlons that substitute freerunning through the urban structures for street running. The swimming portions are done in the habitat's open freshwater lakes or in lane pools.

Obstacle courses that interrupt running segments with rope climbs, barrier jumps, balance tests, crawls, mud or ball pits, climbing walls, obstructing columns, strength challenges, and other barricades or physical tests challenge an individual's strength, agility, endurance, and mental will. Assault courses increase the difficulty by adding either hand-to-hand or ranged combat evaluations. The Digi-athlon competitions also include obstacles that require cyber attacks or problem-solving to defeat, such as gates locked with mechanical puzzles and pathways that only open up when an encryption key is broken.

Though most habitats do everything possible to minimize the sense of isolation and simulspace can take off the edge for the majority of morphs,

there are some people who just have to get away from it all. Only the cities of Mars and Titan even begin to approach the splendor and diversity of Earth before the Fall. Many orbital habitats cluster around Lagrange points or concentrations of natural resources, which helps alleviate this problem. A short inter-habitat shuttle trip within the same constellation can literally transport a morph to an entirely different world than the one they just left. Those with the means can use egocasting to do the same if they are looking for something different than what their physical locales can provide. Gerlach in Venus orbit and Paradise at the Earth-Sun L1 are popular "getaways" because of their comforts and amenities.

HABITAT SYSTEMS

Source: *Lectures on Space Habitat Systems Engineering and Design*, Prof. Sana Medalie, Titan Tech [Link]

Except for exohabitats open to the local environment, every station and colony is effectively a closed ecosystem designed to keep its inhabitants alive as efficiently as possible. Complex systems are in place to keep the cycle of life going and every detail of their operation must be attended to. In some cases, we've found that there just isn't a substitute for Mother Nature, so we've developed bioengineering analogues to do the hard work for us. There are even a few in our profession that eschew mechanical systems entirely in favor of biosystems.

Remember that every habitat must balance the requirements of its owners and operators with the needs, wants, and desires of its inhabitants. These are our homes we're talking about here. Just as with any city back on Earth or Mars, biomorphs need food, water, shelter against the local environment, sanitation, and communications. Public services like security, fire protection, power, and local transportation are common. Atmospheric generation and processing is perhaps the top priority, though. As habitat engineers, it will be your job to design, build, and sustain the systems that provide all these essentials.

If this sounds like a daunting task, rest assured that it is. We incorporate safety margins where ever we can, but there are simply too many permutations of the interactions of interdependent systems for us to discuss everything that could possibly happen in this class. There are infomorphs that have dedicated their existence to resolving the problem of optimal systems control. You will have to learn how to make the best decisions you can with the information you have available. Intuition and discretion are what separate the good from the great.

(PHYSICAL) ACCESS CONTROL

Though some extreme social groups have chosen to isolate themselves since the Fall, effectively locking themselves inside their habitats, most colonies have some method for allowing morphs, bots, and craft to move inside and out. The level of control largely depends on the size of the habitat, its configuration, and local regulations and governance. For example, the airlocks and docking stations on cluster anarchist communities like Locus are controlled by individuals and collectives, while the Jovian Republic's Reagan cylinders have strict security controls that require both proper identification and authentication for access. Even stations with open access airlocks and ports will almost always have AIs dedicated to monitoring the portal and watching for trouble.

AIRLOCKS

The airlock is the standard system for individuals to conduct extra-vehicular activities while keeping the pressurized volume intact. The simplest airlocks consist of an interior door or hatch, a pressure chamber, and an exterior door or hatch. Internal volume sufficient for two suited individuals is the engineering minimum standard because of the long-standing practice of employing the buddy system for EVAs. Large working airlocks can include a pre-breathing and suit donning chamber, heavy suit and equipment racks, capacity for two dozen workers, and multiple exterior doors. Multiple interior doors are uncommon, as a precaution against increasing the number of points of failure in the system.

Standard operating procedure is for the users to don their suits, enter the airlock chamber, close the interior door, depressurize the chamber, and then open the exterior door to space. The procedure is reversed to re-enter the habitat. Pressurizing or depressurizing takes about 12 seconds on average. When not in use, both chamber doors are kept closed to provide two-fault tolerance against a breach to vacuum or the exterior environment.

Some airlocks are also designated as crew transfer points and equipped to capture docking adapters on shuttles and other small spacecraft. Tin can and cluster habitats, where internal volume is at a premium, often have dual-use systems like these to avoid the expense of dedicated spaceport facilities.

More simplistic "airlocks" are sometimes used on Mars, Venus, and similar worlds where the habitat exterior has a different non-toxic atmosphere rather than vacuum. These are composed of a simple set of two counterweighted doors and a transition chamber, so that when one door is open the other is pulled shut. These are much quicker to traverse and effective at keeping the habitat's interior atmosphere intact as long as the doors are not forced open.

SPACEPORTS

Some habitats and all spaceyards are specifically designed to provide dedicated support for space vehicles, including and up to military fleets and heavy transports. Basic spaceport facilities for microgravity habitats usually consist of a dedicated docking module

with multiple ports and robot arms for berthing craft with limited in-space maneuvering. While docked, the craft is still in vacuum and is effectively another module of the station. Extendable tunnels can be made available for spacecraft with protrusions that prohibit a direct mate. These tunnels range from simple light fabric and plastic tubes pressurized with air to smart fabric designs or more hardened walkways.

Colony habitats like O'Neill cylinders and other large stations often include protected shuttle and small vehicle bays that allow repair crews to work in a shirt-sleeve environment. These bays are effectively airlocks large enough for shuttlecraft to pass through. If the station has a de-spun section permanently in microgravity, shuttle bays are typically located there. Otherwise, the spaceport must include some kind of capture mechanism that translates the docking craft into the habitat's spinward motion. This is easiest if the spacecraft can match the habitat's spin rate and approach along the long axis for capture by a robot arm or landing platform.

Spaceships that are too large for pressurized bays require their own set of procedures and systems. Unpressurized spacedocks provide structural spars for mooring and crew transfer tunnels that mate with the vehicle's airlocks. Space construction yards are functionally little different, except that they are dedicated to spacecraft manufacturing and assembly. As a result, they tend to be much more utilitarian in design and have less in the way of accommodations for passengers or crew. Many yards are entirely automated and only have emergency shelters for biomorph workers or visitors as a precaution against the occasional solar flare or cosmic ray shower.

Larger or high traffic stations will have dedicated space control systems, typically managed entirely by AIs and infomorphs, to manage and oversee shuttle and spacecraft traffic, docking, flight plans, cargo transfers, and customs declarations.

Entrance and Customs

Once inside the habitat, new arrivals are typically divided into residents and visitors for processing. Residents often have the benefit of an expedited or cursory security screening. The level and implementation of security can vary widely, from physical security check-in points little different to that of airports on pre-Fall Earth to entirely automated systems that require intervention only if contraband or a discrepancy is detected. Examples of such discrepancies can include inconsistent credentials, a measured mass-to-volume ratio above or below established norms, physiological indicators of high stress, and erratic behavior.

Many stations require visitors to report to a kiosk where they can declare their belongings, state the purpose for their visit, and note the planned duration of their stay. These inputs are then checked against the individual's required declaration of intent that was filed before departure. If there are any inconsistencies in a visitor's answers that cannot be resolved by the AI, a customs or security official is called to discuss the matter directly and intervene as appropriate.

Only the largest space habitats and surface colonies have on-site immigration facilities dedicated to in-processing new, unanticipated arrivals. Paranoia against external threats and limited resources drive most habitats to require morphs seeking permanent residency or citizenship to pre-register, successfully argue added value to the community by their presence, and obtain at least provisional approval before departure. These individuals are then flagged upon arrival for a more rigorous security protocol and identity confirmation as well as increased surveillance for the duration of their visit.

Almost all mid-sized and larger habitats have radiation detectors and other sensors in place to identify antimatter, nukes, and similar potential weapons of mass destruction.

ADMINISTRATIVE

The management of even a small habitat's various interdependent systems can be an arduous task. Early space stations required as many man-hours for maintenance and repair as, if not more than, their mission operations. Without centralized control on-orbit, large ground teams were required to monitor and control each subsystem—including Communications, Environmental Control & Life Support, Power, Thermal Control, and Avionics, to name a few—and to be alert for cascading effects from changes to the other systems.

Automation and ubiquitous networking now allow support personnel in an on-site control center to conduct multiple tasks in parallel and delegate authority to local subsystems so they can focus on more immediate problems. Software and AIs developed with simple but robust machine learning algorithms assist the control operators by paring down the deluge of data into discernible trends and deviations from control thresholds. Many operators have the data and analysis fed to their personal muse.

Control center positions often include Communications, Data Systems, Environmental & Thermal Control, Power Systems, Mechanical Systems (robotics, linkages, moving parts), Motion Control (station-keeping, attitude control, propulsion systems), and Operations (which can cover EVA and visiting vehicles). Large habitats like O'Neill cylinders may include watch officers for public services—such as fire, security, and transportation—on their control teams. A senior duty officer may serve as the team lead and report ongoing activities or emergency events to the relevant authorities.

Not everyone is comfortable with such a tightly integrated system. Some fear vulnerability to a decapitation strike that would take out the control center or suborn it to another's will. Others have philosophical objections to such a concentration of power. As a result, some habitats (particularly autonomist stations) have a highly decentralized system that places control in local nodes responsible for subsystems and cross-communication. If a node malfunctions, is destroyed, or becomes compromised, the network can excise that node and divide its responsibilities amongst the remainder.

COMMUNICATIONS

Every person in a habitat that uses inserts or an ecto is a part of the internal mesh. Though most habitats have a distributed system of mesh nodes that facilitate data transfer across the various systems and allow varying levels of public access, this basic architecture does not define the topology of the network as it would have in space stations that preceded the nanotech explosion. Instead, the vast majority of habitats have a user-defined mesh topology with nearly countless and overlapping layers of access, range, and intent. The public mesh is a cacophony of local spime data, advertisements, public service announcements, open discussion groups, news broadcasts, and entertainment. Private networks, some of which touch each other and most of which do not, are used for discreet information sharing, whether legitimate or not. Many of the private networks can be seen, but cannot be accessed without proper authentication or an invitation. Others actively try to conceal themselves in the noise of the public nets.

AR visualization software can actually be used to help an individual, usually through a muse, manage their interest in and access to all this data. Though the raw data is the same, two different morphs may have two entirely different perspectives on the mesh topology. Some memetics experts are even beginning to study this phenomenon to better understand the social structures of colonies by examining which visualizations are common and finding sharp divergences in mesh populations.

LONG-RANGE COMMS

All of this happens within the immediate vicinity of a given habitat. Long-range communications still tend to be sharply defined by installed hardware because of the vast distances between most habitats. Each habitat itself forms a node in the ad hoc interplanetary communications network. Modular comm arrays are installed on the exterior of the hull and connected to the computers generating the transmission by fiber-optic cable. This prevents tampering and interference from the local mesh.

The comm arrays themselves are arranged to give all-aspect viewing of space, if at all possible. Occultations from planetary objects and debris mean this is an imperfect solution, but managing those fluctuations in the comm links is what good software or an expert is for. A standard integrated array will have a cluster of monochromatic cells for laser beam reception, a tight-beam laser transmitter, a microwave transceiver, and an active electronically scanning radio array. While a small tin can habitat might have as few as four of these clusters arranged in a tetrahedral formation, a massive colony like Extropia will have hundreds.

Some communications hubs, especially those in the outer system, will maintain inflatable antenna loops up to 100 kilometers in diameter to pick up signals traveling from one side of the system to the other. Even a highly collimated tight-band beam will diverge to a width measured in tens (or more) of kilometers over such distances.

Neutrino communications diverge from this standard because they are relatively large, have a significant energy requirement, and solid matter is transparent to the signal. To protect this investment, most habs with neutrino transceivers will locate them near the center-of-mass or behind the power reactor shielding. This allows the operators to use as much physical mass as possible to protect against outside attack with no effect on the transmissions. The most expensive neutrino transceivers have hundreds of multiple tight-beam emitter/receiver pairs arranged in a spherical fashion to permit multiple high-bandwidth links in parallel.

Egocasting relies on the security of the long-range communications system for its integrity. Shielded fiberoptic cable is almost always used to transfer the ego data to the intended transmitter. Quantum encryption is standard. Neutrino farcasters are too easy to intercept, even with encryption, so most egocasting services use line-of-sight laser for moving egos within local clusters of habs and millimeter-wave radio for long distances. If an atmosphere must be penetrated by the signal, centimeter-band radio will be used because of attenuation effects on millimeter-wave signals.

Darknets

In a civilization largely based on panopticism, there will always be people who seek to move their data beyond the watchful eyes of others. There will also always be people who provide those services for a price. Evading network and physical security is not a challenge for the uncommitted. Darknets within the range of the local mesh are often based on portable quantum transceivers that scan for frequencies dominated by local noise and operate in that region. Self-protection software monitors the bands and changes the operating frequency as necessary, sometimes even transmitting on multiple bands in parallel to stay under the signal-to-noise thresholds that would attract attention.

Physical darknets based on shielded fiberoptic lines avoid the problem of attracting attention in the data cloud, but must be installed in such a way as to not be automatically removed from the system by maintenance bots or accidentally create thermal and power signatures that indicate an anomaly. One way of doing this is to have nanomachines embed capillaries in the sheathing of existing lines. Physical darknets also force users to have access points that run the risk of being compromised, unless the cabling itself just serves as a private conduit for mesh users who know how to tap the line.

Darkcasting presents an entirely new level of complexity, given the natural chokepoints in data flow through long-range comms and the unbridled paranoia of legitimate egocasting services. The easiest way to do a clandestine egocast is usually by bribing local officials to look the other way or hiring someone to wipe the records in the wake of your departure.

That is still too much of a risk for some egos, however. Some legitimate private organizations maintain their own farcasters with the permission of local authorities, by virtue of whatever vital service they perform. The right combination of cred, contacts, and rep might gain access to this resource. Crime syndicates have also been known to conceal illegal farcasters in the power and data fluctuations of cover businesses, such as orbital manufacturing. The truly desperate can possibly even arrange to sell their body in return for smuggling their cortical stack onto a spacecraft that will then farcast the ego within.

Defense Systems

The vast distance between astronomical objects and most gravitational anchor points where stations and colonies are located means that communities are, by necessity, responsible for their own protection—against both natural threats and those who would do them harm. Isolation is a protective measure in and of itself. Spaceships can be seen coming, as long as they aren't occulted by something else, and long-range transmissions are quarantined and authenticated before the data is allowed into the habitat's primary system.

This protection is not absolute, though. Cold asteroids with a low albedo can be difficult to track on optical and thermal sensors. Mercenaries might sneak into close range by using commercial transport as cover. A determined adversary may even forgo subterfuge and attempt the direct assault. All of these possibilities must be considered and mitigated to the extent the resources and governing philosophy allow. Many habitats contract out these functions to private security firms and leave it up to the experts.

External defense is commonly performed by constellations of satellites and/or drones co-orbiting with the habitat. Distributing the sensors and weapons over multiple platforms and away from the main habitat makes it harder to disable the system and safer for the residents. Most civilians don't want to live near directed energy cannon and high explosives. On the other hand, external platforms can be hijacked and used against the habitat. The advantage of a weapons emplacement on the side of a station is that it can't be used to target the station. Each strategy has its risks.

Kinetic attacks inflict damage proportional to the square of the impact velocity. Thus, incoming projectiles must be deflected or vaporized to effectively stop the threat. Only doing enough damage to break up the projectile into smaller chunks just makes for multiple, smaller incoming targets. Directed energy

weapons are the method of choice for kinetic defense because they will turn small objects into carbon compounds and inert gases and burn off mass from larger projectiles to redirect them. Conversely, directed energy attacks can be mitigated by clouds of dust or surface coatings that break up the beam.

Defense against incoming spacecraft isn't as simple as in pre-Fall Hollywood and Bollywood vids. Taking out the propulsion system just means the vehicle will continue on its last trajectory indefinitely. It won't miraculously come to a halt. Instead, the interlopers are attacked in such a way as to cause more pain to continue to press their assault than it is worth. Beam cannons are employed to ablate any armor and weaken the hull from far away. If that doesn't send the message, the radiators are pelted with clouds of pellets to breach the ship's vital cooling loop.

After attempts to get the enemy to divert from an intercept course fail, the next course is to eliminate the threat completely. Anti-ship missiles with shaped-charge armor penetrators can open up pressurized volumes to space. Teller mines detonate tactical nuclear weapons to form powerful X-ray lasers that will both ablate the hull through thermal erosion and cause lethal exposure to neutron radiation from secondary effects. Smart dust can be employed to both physically and electronically attack weapons batteries, airlock doors, communications and sensor arrays, and other vital systems.

Fixed satellites only require propulsion for station-keeping, so they are typically used for mounting heavy long-range beam weapons, deploying large sensor arrays, and serving as depots for attack drones. Attack drones have the advantage of mobility, so most are little more than a fusion jet with a sensor package, missiles, and a beam cannon or railgun strapped on. They are intended to close the distance quickly, perform high-acceleration maneuvers that would kill a biomorph, and conduct precision strikes on key targets. Of course, the enemy spacecraft can carry drones of their own. The outcome of a battle often depends on the superiority of drone hardware and combat management software and can be decided by the survival of a single drone from that clash.

Secure communication in a defense network is invaluable. As a result, quantum farcasting is ubiquitous in defense systems that require wireless comms. Tight-beam optical communications are typical for line-of-sight transmissions, while encrypted millimeter-wave radio is the standard over long ranges. The Jovian Republic is suspected of using quantum-encrypted neutrino transceivers to coordinate their fleet of dreadnoughts, taking the mass penalty in return for omnidirectional fleet networking. The expense of quantum-entangled communications tends to limit their use to highly sensitive covert operations that may require instantaneous, if limited, information exchange.

Detecting the enemy is always the first part of interception. At distances such as those between planets, the easiest tracking is done by watching the thermal signature move across the near-absolute-zero background of space. This only tells a habitat that someone is coming and gives a rough estimate of the contact's trajectory. Radar is the most common method of pinpointing a contact's size and mass and determining an accurate course and estimated time of arrival. Spectroscopy—separating out the light into its component spectra—can be used to determine the vehicle's exhaust characteristics and thus likely propulsion system. At tactical ranges, lidar and tight-beam radar are used to construct a high-definition 3D map of the contact, correlated with IR imaging of major heat sources.

When all else fails, many habitats still have their own defensive batteries to deal with drones, missiles, or other spacecraft that penetrate the outer screens. Beam weapons are often preferred because they can respond rapidly to many threats without creating additional debris. Lasers and railguns are often employed as point-defense weapons, while plasma cannon are favored for attacking armor. Missile launchers are almost always mounted as external modules with integral ordnance bays. Shaped plating inside the bays is designed to deflect an accidental detonation away from the primary hull.

Emergency Systems

Whether by accident, deliberate action, or the ravages of time and space, the protective cocoon of a habitat will almost inevitably be breached. The measure of good habitat design is in its emergency response functions. Fire, decompression, and catastrophic structural failure are the top three issues every habitat must be prepared for.

Fire

Fire will consume breathing gas, destroy critical systems, and weaken structural integrity. If the blaze continues uncontrolled, the increase in pressure can seal hatches and exceed a module's burst strength. Just as on the seagoing ships of old, fire is a morph's worst enemy in space. In modular habitats or those that can be partitioned internally, the section that hosts the fire is typically sealed while appropriate fire suppression techniques are applied. To avoid electrical fires, most automated fire suppression systems are based on flooding the affected area with an inert gas or non-conductive foam. If this fails, an emergency purge to vacuum may be required to stop the fire before it spreads. In extreme cases, entire modules can and have been jettisoned to save the rest of the station. Aerogel is particularly good at resisting fires and so aerogel barriers are used as firewalls. Metallic foam can also be constructed with fire-retardent gases that are released when melted. Diamond, on the other hand, burns.

Depressurization

Unplanned depressurization events are actually not terribly common. Because the hostile environments

outside most habitats are an ever-present threat, great care is taken in design and construction to mitigate the risks of a hull or dome breach. The infrequency of such incidents does not lessen the abject terror that happens when they occur, though. It is standard practice in most tin cans and cluster habs to include an emergency hull repair kit in every module.

Once a leak or puncture is detected, the user sprays a self-sealing, self-hardening foam into the internal volume that can plug a hole up to five centimeters in diameter. This is to address the immediate danger of the decreasing internal pressure. The kit also includes composite fabric patches and a self-setting adhesive to complete the seal. Many kits incorporate spimes in the patches that report pressure and temperature and structural strain levels in the vicinity to ensure emergency responders have time to act if the patch is going to fail.

Larger breaches almost always require the affected areas be sealed until venting is complete and rescue crews arrive on-site. If not killed or critically wounded by flying debris, unprotected biomorphs have a very narrow survival window during rapid decompression. Habitats with massive internal volumes enjoy longer recovery windows and can withstand larger breaches without fundamental structural integrity being compromised. Even so, hazard stations often carry emergency face masks that seal around the ears and provide a few minutes of oxygen. This is a relatively cheap and surprisingly effective way of tipping the odds a little more towards survival.

Catastrophic Damage

In the event of catastrophic damage and/or a cascading core systems failure, the call to evacuate will be sent out over whatever means remain—mesh, audio/visual displays, and personal contact. Inhabitants are directed to don suits, pack only what they can carry, and go to their assigned lifeboat boarding stations. If enough power and time are available, egocasting can be done to expedite the evacuation process. If not, ego backups can be transmitted or shunted to cold storage for later retrieval.

Lifeboats are typically sized for up to 100 people and carry enough consumables for eight days. Four zero-g toilets are standard. Solid-fuel jettison motors clear the lifeboat away from the station and gyroscopic stabilizers prevent the lifeboat from tumbling. Docked shuttles and spacecraft are also used to ferry evacuees and tug ejected lifeboats to another station or rally point where a rescue ship can take on survivors.

On larger stations, it is quite likely that there will not be enough lifeboats for the entire population. In this case, priority is always given to biomorphs. Children are given first access, but beyond that each habitat has their own procedures. High status figures may be berthed first, whereas others seats are given to the first people to claim them. In more managed evacuations, lotteries may be held. Synthmorphs and pods are evacuated last, though they are sometimes carried externally on lifeboats or tugged in open-vacuum pods.

The worst-case scenario is that the station is dying quickly, there are no more lifeboats, there are no more shuttles, and there is not enough power to egocast out of Dodge. Individuals may still have a chance in this situation by donning a suit, taking possession of resupply tanks and an emergency beacon from a hazard station, and evacuating through an airlock. Remember to turn the beacon on. If a group evacuates in this manner, they should tether themselves together to make an easier target for rescue services to see.

Escape still may not be feasible, though, especially without an emergency farcaster. In that case, a biomorph's last resort is to protect its cortical stack as best as possible. If a spacesuit is available, don it and set the oxygen to the minimum safe level for the morph type. Though physiological death is inevitable if rescue does not come before the air runs out, the morph will already be unconscious at the time (minimizing pain and suffering) and the brain kept in the best possible condition for the longest amount of time.

Environmental and Life Support Systems

From the smallest tin can to the largest cylinder colony, every habitat must provide a breathable atmosphere, waste management, and thermal control. Fresh oxygen must be supplied and carbon dioxide must be removed from the air. To grow plants, an artificial nitrogen cycle must be maintained. Fresh water must be available and waste water reclaimed. Whether through mechanical or biological means, each habitat is its own miniature ecosystem.

Breathable Atmosphere

Though the first space explorers operated in a pure oxygen environment, such practices are rare anymore because of the extreme fire hazard. Most habitats keep their internal gas pressure and mixture of nitrogen and oxygen comparable to pre-Fall Earth normal to ensure a minimum safe level for biomorph survival. The most common oxygen generators use electrolysis to split water into hydrogen and oxygen. O_2 is vented to the inhabitable volume, while the hydrogen can be collected as fuel or dumped to vacuum. Reclaimed greywater is the usual source for these generators, as living inhabitants take first priority for fresh water.

Solid-fuel oxygen generators—often called "oxygen candles"—work on the exothermic reaction of an oxygen-releasing compound, such as lithium perchlorate, ignited by a mechanical firing pin or a burning fuse. The oxygen gas is cooled and filtered for particulates before being released. Oxygen candles have a nearly indefinite shelf life, but malfunctioning insulation or fuel contamination can lead to catastrophic fire hazards. As a result, they are more popular as emergency generators.

Habitats with enough interior surface area to support large green spaces can actually provide integrated oxygen production and carbon dioxide scrubbing through plant life, be it grass, trees, or, even, algae. However, most "green" habitats still require electrolytic oxygen generators. Only a few habitats are actually large enough to sustain the number of plants and trees required to match the daily oxygen consumption and CO_2 generation of baseline humanoids. Even then, genetic engineering is required to increase the plant respiration rates to high enough levels.

Carbon dioxide is toxic to biomorphs as it accumulates. Headache, dizziness, shortness of breath, and confusion set in above 5% concentration by volume. Muscle tremors, decreased vision, and unconsciousness occur at exposure to 8% concentration by volume for several minutes. This can happen fairly quickly in microgravity, as there is no buoyancy effect to separate gases by density. Constant airflow is necessary to prevent dangerous "pockets" from forming. Early explorers depended on lithium hydroxide canisters to scrub CO_2 via chemical reaction, with water as a byproduct.

Most carbon dioxide removal is done with swingbed systems that require little power and are self-regenerative. CO_2-enriched air is drawn into an adsorbing bed of amine. Upon exposure to vacuum, the amine releases the carbon dioxide and is effectively recharged. By using alternating adsorption beds, the air can be continuously scrubbed. With additional filters, water and oxygen can be captured and recycled before the beds are vented to space. These systems are efficient enough that their only real limitation is the air flow rate.

Nitrogen Cycle

Atmospheric nitrogen is non-reactive and typically serves on spacecraft and habitats to maintain a comfortable gas pressure without elevating the oxygen content above that required for habitation. However, plants require fixed nitrogen for healthy growth. In microgravity, nitrogen fertilizers produced industrially are infused in the plant growth chamber's feed stock. This can be an expensive process, though, and is avoided on the large habitats with artificial gravity and more natural growing areas.

Bacteria in the soil or in the nodules of nitrogen-fixing plants, like legumes, converts nitrogen in the air into ammonia, which is released when either the bacteria dies or the plants are composted. Through crop rotation, colonists can sustain a local nitrogen cycle of absorption and release virtually indefinitely. Industrial nitrogen fixation synthesizes ammonia from the catalyzed reaction of nitrogen and hydrogen gas with a magnetite catalyst at high temperature and pressure. Because the gases can be recycled, the completed process is as much as 98% efficient and was responsible for a majority of all agricultural fertilization before the Fall. This is the primary method of producing ammonia and other nitrogen compounds when they are not available naturally or are required on short time scales.

Water

The water cycle in a habitat is one of its most essential functions because water is the universal currency in the solar system. Even infomorphs have a hard time getting on without a key base material in industrial processes. It is no coincidence that the major population centers tend to have local water resources.

Only Mars and the subsurface oceans of some moons have accessible liquid water, so it arrives at most habitats in the form of ice. The first step in the process is using vapor-compression distillers with a dual evaporator-compressor system to eliminate contaminants both lighter and heavier than water vapor, leaving only pure water at ambient temperature to flow out. From there, the potable water is pumped throughout the habitat for a variety of uses. Many microgravity stations also treat the purified water with anti-microbial nanobots.

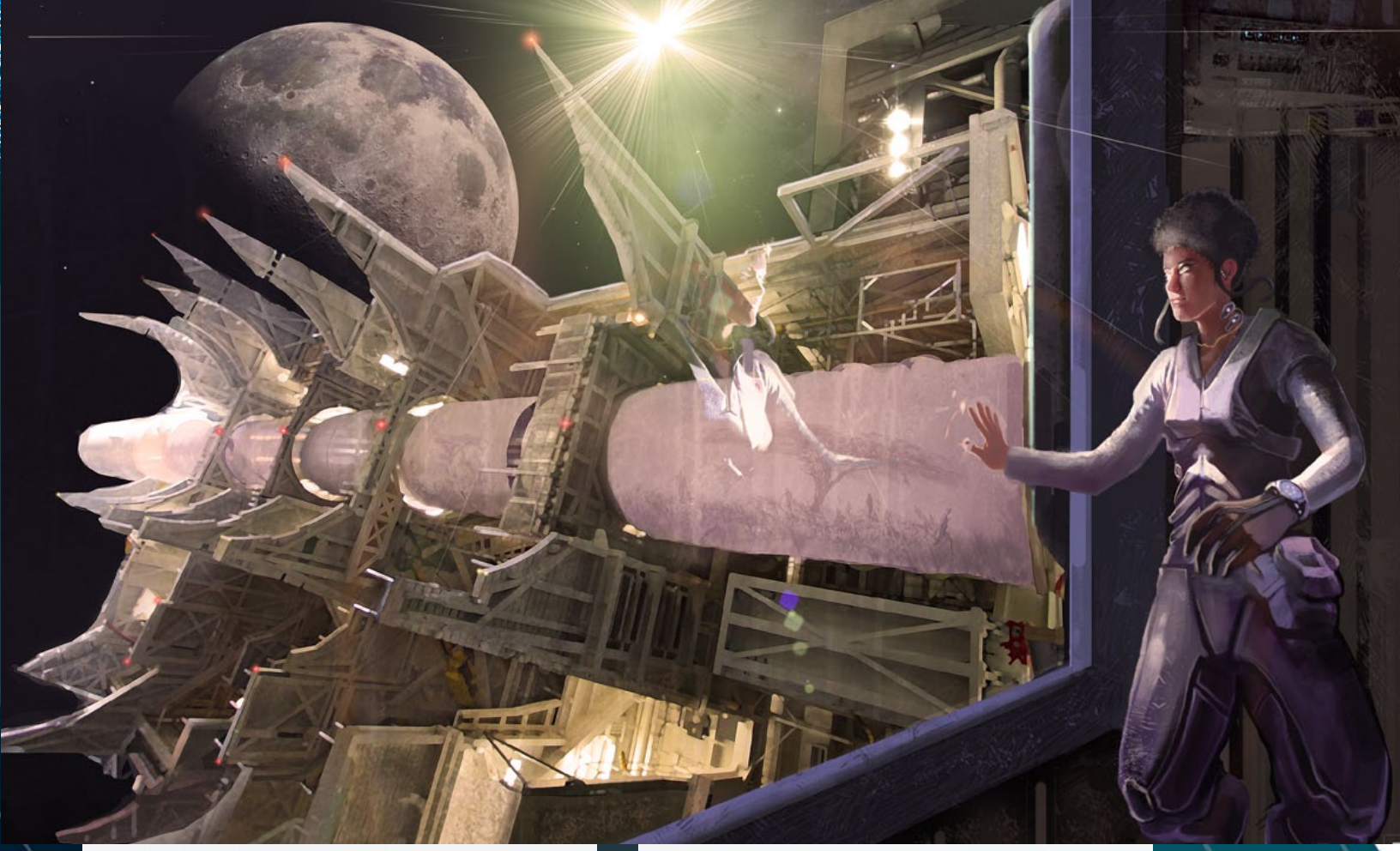
Water transport must be done at pressure or through capillary action in microgravity habitats because there is no intrinsic force to assist. As a result, proper wetting of soil, for example, becomes problematic. Capillary "nets" that spread water distribution from the input in a plant growth chamber and draw out any excess water flow to the chamber output can help with this. Waste water, including from biomorph activities, must be removed by suction.

Habitats with artificial or local gravity have the advantage of a natural flow direction for plumbing. Some larger colonies even provide a pseudo-random rain system designed to maintain ideal moisture levels while simultaneously providing the psychological benefits of changing weather. At the designated times, water droplets at elevated temperature are vented into the atmosphere for condensation. This can be easily done in a dome structure on a planetary surface, while a rotating habitat requires some sort of "overhead" irrigation that avoids trapping the water near the axis of rotation.

Waste water is usually sorted into two categories: sewage or "blackwater" contaminated with urine, feces, or industrial waste and "greywater" from washing, bathing, atmospheric processing, and other activities that do not introduce toxic materials. Sewage is routed to vapor compression distillers for purification, while greywater can be recycled for such things as plant irrigation and oxygen generation. Spimes monitor water quality throughout the process and immediately identify the responsible authorities if a leak is detected or a contaminant is introduced to the fresh water supply.

Ecosystems

Green space is considered by some to be the crowning achievement of space settlement. With greenhouses, gardens, grass fields, and (in habitats large enough) forests, transhumanity can grow food, provide psychological comfort, scrub wastes, and provide oxygen. Next to the terraformation of Mars, cylindrical and torus habitats are the closest facsimiles of old Earth and often



the easiest for infugees inhabiting new bodies to adapt to. Selective breeding, genetic mods, and hybridization exchange programs across habitats have allowed post-Fall horticulture to thrive and prevent evolutionary dead ends from destroying entire biospheres.

Succulents, such as aloe, agave, and cacti, are extremely popular for personal and decorative use because they are tolerant of temperature fluctuations, require little water, and come in a variety of shapes, sizes, colors, and leaf forms. Food gardens and farms tend to focus on producing the most nutritional content in the smallest area possible and are typically managed by professional agriculturalists who monitor soil conditions and plant health constantly. As a result, superfoods that could never have arisen naturally dominate. Owners of commercial operations protect their intellectual property—the genetic code of their product—fiercely.

Grass fields, parks, and forests tend to be common areas primarily intended for personal relaxation and air cleaning. Though O_2 and CO_2 respiration rates are not high enough to sustain large populations on their own, these green spaces are actually quite effective at removing other contaminants and improving general air quality. Areca palms, pothos ivy, spider plants, and ficus plants and trees are common ancestors of space-borne plants for this reason.

Runoff water from green spaces and artificial rain is almost always reclaimed as greywater, unless it is over-concentrated with fertilizers or other chemicals. In that case, the runoff is captured as normal sewage and treated accordingly. Even the wealthiest habitats get every possible use out of every last drop of water.

HEAT CONTROLS

Even though people often think of space as being cold, heat rejection is actually one of a habitat's most serious issues. Colonies in either an atmosphere or hydrosphere can reject excess heat from power generation, biological activity, and other station operations to the local environment. Natural convection does the rest. In microgravity and vacuum, though, there is no buoyancy to drive convection. There is no external fluid to carry away the heat by conduction, either. Thermal radiation is the only natural process.

This is a problem because the vast majority of space habitats generate more excess heat than can be removed by ambient heat radiation through the hull. The most common solution is an active thermal control system. Greywater is pumped past coldplates and heat exchangers inside the habitat walls and is heated in the process. Before continuing on for purification or reclamation, the greywater passes heat exchangers with a closed ammonia loop that carries the heat to external radiators.

In some cases, the surface area required for external radiators is infeasible. Heat evaporators that actually vent the hot liquid to space are an option for those circumstances. Many soft spacesuit designs incorporate semi-permeable membranes that wick sweat from the body and evaporate it to space. Bioengineered

analogues of this technology can be used for heat exchange to space on organic habitats.

Infrastructure

The outer hull of any station or colony is akin to a suit of armor. Whether manufactured from advanced nanopolymers, high-strength metallic alloys, inflatable composite materials, fused rock, or ice, the exterior shell must contain the internal volume, protect against kinetic impacts, mitigate radiation transmission, and account for unique local threats to the habitat.

In microgravity, most loads come from propulsion or mechanical forces from objects of significant mass in motion. Internal atmospheric pressure can be easily distributed over structures designed to withstand micrometeoroid impacts and the vibrational loads from internal machinery or crew activity. Thus, the hull itself in a tin can, cluster, or cylindrical habitat also serves as the primary structure for the habitable volume. Environments where the external pressure is higher, such as under the Europan ocean, require significant structural adaptations internally that are intended to keep the habitat from being crushed.

Windows

Windows serve a number of functions, from helping reduce the stress of confinement to providing line-of-sight for external operations for someone monitoring an activity in space from within the pressurized volume. They can be as small as portholes and as large as the immense window "stripes" on O'Neill cylinders. Windows are almost always multi-layered to prevent both a hull breach and contamination of the optical pane. The presence of orbital debris and the transparency of most optical materials to cosmic rays mean that many windows have exterior shutters that can be opened and closed from the inside, as needed. Quantum dot and other technologies allow for windows that can be changed from transparent to opaque or to an active display with simple commands.

Observation bubbles and cupolas with segmented windows are used to provide a wider field-of-view than is possible with porthole windows. They are often sized so that a morph can float or climb inside without obstructing traffic in the main volume. However, this is effectively a larger hole in the main hull and the supporting structure must be proportionally larger. To avoid this problem, it is not uncommon for tin can and cluster habs to build separate observation modules that attach at the nodes and limit the size of windows in the primary modules.

From a distance, the window stripes on O'Neill cylinders and their kin appear to be single-piece structures. This is an artifact of scale. These enormous windows are comprised of many small sections on a lattice frame that carries the structural load from the internal atmospheric pressure. Each pane consists of three transparent layers—a thin outer layer of aluminum oxynitride ceramic for projectile impact protection, a middle optical layer of sintered alumina nanomaterial, and an inner polymer layer to prevent shattering if the outer layers are breached. Two to three panes per section provide redundancy. This arrangement mitigates the spread of window damage in an emergency and allows for relatively quick, standardized repair.

Internal Architecture

The internal architecture of a habitat is as flexible as the designers and the pressurized volume allow. Tin cans and cluster modules in microgravity are usually cylindrical shapes intended to maximize efficiency. Equipment racks and even crew quarters are thus designed to fit in semi-cylinders flush with the pressure shell. This leaves the core internal volume open for people to do work and move between modules. Curtains and retractable polymer sheets provide only a modicum of privacy. Hatches between modules are similar, if not identical, to airlock hatches and the only real means of sealing off from the rest of the station.

As the size of the habitat increases, so do the options. At the most basic, recyclable walls can be extruded from plastic, arranged as the inhabitants desire, and broken down as needed. This is not uncommon in spin habitats without large, contiguous volumes. Otherwise, the internal volume is divided up much like submarines and spaceships, with pressure bulkheads that can be sealed in the event of an emergency and the internal spaces defined by their function.

On the scale of a torus station or larger, free-standing structures can be built on the floor or soil level no different than any on Mars or old Earth. The style and form depends entirely on the cultural and regulatory norms of the residents. If the spin gravity is less than 1 g, taller, lighter structures are possible. Gliders and motive-powered flight are an available mode of transportation in such habitats with a dense enough atmosphere to generate lift.

The most common building materials in large spin habitats tend to be light, cheap, local, or some combination of those properties. Bamboo is very popular because it can be relatively easily grown and maintained and pressed into an engineered hardwood for construction material. Excess metal from the fabrication of a colony's primary structure is easily recyclable for internal uses.

Habitats with a soil layer tend heavily towards adobe walls because they are durable, excellent thermal reservoirs through a day/night cycle, recyclable, and almost infinitely customizable. Though maintenance and upkeep is often performed by robots that extrude adobe plaster as needed, many of the people who live in such habitats prefer to actually build the structures themselves. Making adobe bricks and assembling the structures are strong community-building exercises and create a tangible sense of connection between the residents and their homes.

Monitoring, Maintenance, and Repair

Information overload is extremely easy to come by when monitoring a colony with tens of thousands of residents, all relying on the successful parallel and interdependent operation of hundreds of systems and subsystems to stay alive. There is simply too much data for any one ego to watch everything. Most infrastructure maintenance is completely automated and handled by AIs with little direct transhuman oversight. Though spimes are widely used to provide instantaneous information as needed, most sustaining operations are automatically processed and handed off to robots for regular maintenance. Even structural repairs that bring the system back within design tolerances are often handled immediately and simply noted in the system log.

Transhuman oversight is only brought in when a trend exceeds control limits—such as a progressively failing structural member—or when a severe anomaly such as a deliberate attempt to circumvent the system is detected. At that point, the control authority can access local spimes keeping track of pressure, temperature, structural stresses, power availability, and atmospheric composition. Distributed multispectral optics provide real-time video in, at least, the visual and infrared bands. Connectivity monitors can even inform the operator when parts of the communication network (sensors, mesh, cabling, etc) fail, adding another layer of information.

For example, a breach in the hull that opened the internal volume to vacuum could be detected by pressure sensors reading the local ambient drop and the suction, the breaks in communication between connected spimes or any severed system conduits, and pattern recognition software noting the visible damage. A water tube ruptured by the breach would report the drop in fluid pressure on the other side of the tear and the flow rate into the void, while a damaged power cable would be signaled by the break in the local circuit. All of this sort of information would inform anyone with access to the system about the severity of the problem.

Emergency repair is primarily concerned with stopping whatever danger or anomaly has presented itself until a permanent solution is found. Some habitats actually have an automatic patching system filled with a liquid polymer that expands and self-hardens in vacuum. Like coagulants in blood plugging an open wound, this polymer will fill any hull breach small enough that the escaping air volume does not overwhelm the patch. Affected systems can then be rerouted or shut down, as necessary. Inflatable scaffolding is usually installed over the inside of the breach to provide a seal while the polymer is removed and permanent repair work begins, whether by robots, synthmorphs, or "old school" welders in space suits.

Standard maintenance is a more methodical and controlled process. For habitats that cannot afford sustaining nanomachines, standardized robots with interchangeable tools are common. Often resembling crabs or other small arthropods, the bots have multiple legs with grapple fixtures, onboard sensors, mesh inserts, and reservoirs for carrying stock materials. Thus, the same bots could be used for fixing repair welds on the exterior structure, assembling parts for a work crew, removing grime and debris, or extruding adobe mortar for patching a decorative piece on someone's home. Some can even reprocess waste materials on the spot for recycling with internal microfurnaces.

An alternative to robotic maintenance is the smart animal. Smart rats or mice can be implanted with mesh inserts and neural monitors to effectively allow the control system to direct their behavior. Surviving off the detritus from the habitat, the smart rodents can remove waste products, deposit their own in a pre-determined location, control the population of unwanted insects and other invasive species, and serve as mobile eyes, ears, and noses. Thanks to the behavior control algorithms, their reproduction rate can be limited to population maintenance levels and modified as needed.

Some habitats also employ smart monkeys because of their strength, responsiveness to commands, and ability to learn new tasks. They will also perform menial, repetitive tasks that many fully sapient egos would consider boring or beneath them. This can be problematic, though, in colonies with high pressure to provide physical bodies for infomorphs, as the partially uplifted simians are considered competition for work.

Habitats geared towards agriculture or acting as a nature preserve will also often engineer biocompatible spimes to constantly monitor the health and status of their animal population. While an individual animal may not be any more intelligent than its predecessor on Earth, the behavior of the group can be tracked to watch for emerging patterns or trends that indicate the health of the entire habitat—the "canary in a coal mine" principle.

Mesh Systems

A habitat's mesh is its nervous system. Except for the smallest tin can habs, there are simply too many components, services, and factors and too much information for any single intelligence to oversee. A station's mesh is almost always broken down into decentralized subsystems, each monitored by dedicated AIs and infomorphs. Most subsystems are individual VPNs, often secured with encryption given the importance of their functioning for habitat safety. Particularly sensitive systems may be hardwired rather than wireless for increased security.

Subsystems

Though a single rack of quantum computers has enough power to run all of the basic functions of most habitats, it is standard practice to subdivide mesh infrastructure for safety and security. This prevents

a single point of failure from taking out all habitat systems. Particular regions of larger habitats and specific habitat functions will almost always have their own dedicated subsystems. Certain processor-intensive tasks, such as running AGIs and simulspaces, will have dedicated subsystems as well. This is normally true even on smaller habs where there might otherwise be only one master control system running everything.

Subsystems are almost always slaved to whatever system is in the hierarchy above them. This means that an authenticated user on a master system will usually have access privileges to the subsystems underneath it. Particularly secure systems may require an extra layer of authentication when accessing each subsystem, but this is often impractical for day-to-day operations. A more standard practice is to only apply extra security to critically sensitive devices and functions.

On habitats with a centralized authority (meaning most inner system, hypercorp, and Jovian habitats), there is likely to be a master control network that oversees all habitat subsystems. Depending on their security set-up, this control system may simply have monitoring privileges or the subsystems may be slaved and controlled. There are sometimes complications with these arrangements, particularly given that many inner system stations privatize certain aspects of habitat operations, turning them over to hypercorps. It is not uncommon, for example, for egocasting/farcasting and defense/security operations to be under the private control of a specific company and thus separate from the habitat's master control. In these situations, the overall authority of the hab usually maintains monitoring privileges, but accessing the privately run subsystems requires authorization from that privatized authority. In some cases, even habitat authorities may be forbidden to access certain subsystems.

Elsewhere, a habitat's mesh systems may be far more decentralized and independent. For example, anarchist cluster habitats often have communal reactors, power grids, makers, and harvesters. Many other systems, like recycling, life support, and hull repair are the province of individual modules. Customs, defense, and security, where they exist, are frequently run by specific collectives, syndicates, or worker's councils—or sometimes even flash mobs. By custom, actions taken and information collected by such groups are logged as a matter of public record, available to anyone with a public mesh connection.

On other habitats, control of certain systems is factional. Kronos Cluster in Rhea's orbit has several distinct power grids, split between anarchist and guanxi neighborhoods. There is effectively no security, but the ultimates in control of the spaceport have sole control over customs, defense, and spaceport operations.

Redundancy and backup systems are a common feature. If a specific subsystem fails, there is quite often another one that can be invoked to take its place in whole or part—particularly if the system is critical to habitat function or biomorph survival.

AIs and Infomorphs

AIs, AGIs, and disembodied egos are common in habitat mesh subsystems, keeping a continual virtual eye on important functions. AIs are typically used for routine and non-critical functions, each a specialist in their particular field. AGIs and infomorphs are reserved for more important functions, especially those that require more sapient qualities of discernment, evaluation, and adaptability. These software entities are usually programmed/instructed to alert habitat officials when specific situations, problems, or security breaches arise. Habitats with populations that are more distrustful of AIs and AGIs will lower this threshold and employ embodied personnel to oversee system controls. Critical systems like life support, space control, and defense will almost always have security AIs that provide overwatch against intrusion and subversion.

Habitat Sleeving and Jamming

Many habitat systems are automated and/or feature robotic components, so they can be operated through the mesh via remote telepresence. By the same measure, a habtech may jump into and "jam" such automated habitat systems. This is a common procedure for operations that require fine control or the finesse of an ego. Some stations go even further, hooking up habitat systems to specially designed cyberbrains, enabling an ego to sleeve into the habitat or subsystem as if it were a morph. The sensory input received from a habitat is much different than standard humanoid morphs so this job is unnerving to some, especially those that do not take well to non-standard morphs.

Sleeving a habitat as a morph does not make the ego omniscient or all-perceiving, any more than being in a transhuman morph would make one aware of all of the blood corpuscles, bacteria, and food particles moving through one's body. It does however confer a sense of proprioception: the perception of "body" awareness and where all of the parts of a body are in relation to one another at any given time. This means that the inhabiting ego is aware of the macro-scale state of the habitat, including such things as hull integrity, atmospheric pressure (interior and exterior, if any), the functional status of the power grid and energy intake and consumption, orbital position and velocity, and the position and functionality of major external "appendages" such as axial space docks or the mirrors and windows on an O'Neill cylinder.

VR Simulspaces

Given the high bandwidth consumed by virtual reality simulspaces, many habitats feature hardwired connections for simulspace functions, which also tends to ensure a more stable connection. The particular simulspaces offered vary with each habitat, but a wide array of resort, recreational, and roleplaying sims are usually provided.

Mining and Harvesting

Though recycling is a way of life for virtually every habitat, the laws of physics mean that no system is entirely perfect. Water stores must be replenished. Exterior damage from cosmic radiation and debris must be repaired. Broken equipment must be rebuilt or replaced. Reactors must be refueled. Local mining and harvesting is always the first choice to provide these inputs, if at all possible.

Habitats in orbit around the gas giants—Jupiter, Saturn, Uranus, and Neptune—operate craft specifically designed to fill their tanks with atmospheric gases, like hydrogen and helium, and rocket back to the habitat for offloading. This is the primary method for collecting helium-3 for fusion reactors. Atmospheric mining craft—skimmers—must be adapted for their particular environment to safely operate. For example, Jovian skimmers require larger engines to overcome the planet's gravity well and heavier shielding for electronics. Even virtual crew operating the skimmer require some protection for their digital systems. Saturn skimmers must deploy retractable stabilizers to maintain control in the high winds. Nuclear thermal rockets are common amongst all skimmers because of their high thrust-to-weight ratio and ability to use the ambient atmosphere as reaction mass.

Microgravity harvesting bays are employed by most habitats to bring in outside materials, such as rock and ice, for processing into useful materials. Dense fields like Saturn's rings or debris clumps are relatively easy to mine because there are so many particles and chunks of material that can literally be grabbed with a drone's robot arms and propelled back to the station. These capture drones are disc-shaped to give a 360-degree reach from the main body and allow the plasma thruster in the center to be pointed through the center-of-gravity of any object. Most are no larger than 1.5 meters in diameter, with six to eight articulated appendages that can reach another four meters each.

The mining of objects too big to be brought into the harvesting bay requires a more methodical approach, as there is no point in paying the reaction mass to bring back mining slag. While large ice blocks can be broken up into smaller pieces for delivery, captured asteroids and comets are often covered with swarms of microbots that locate veins of useful material, burrow into the object, and extrude it to the surface for capture drones to carry to the station. Thoroughly blended objects will be encased, much like a Cole bubble at its initial stages, and broken up into their constituents with heat and gaseous reactants. All of this is necessary to maximize the natural resources obtained without adding orbital debris to the system.

Public Services

Not all habitats provide public services, but they are common on larger stations as well as autonomist colonies and populations with dominant memes that include social welfare.

Medical Care

With widespread genetic engineering eliminating most common diseases and defects, much of the medical care on a habitat is geared towards emergency response, research, biomorph cloning, and resleeving. Provisions in a tin can habitat can be as sparse as a single medical rack outfitted with first aid kits and an auto-doc that can perform simple diagnostics, wound treatment, and fluid infusions, while torus habs, cylinders, and Cole bubbles with large populations may have a full trauma center with a hypobaric chamber for decompression sickness and "healing vats" that stabilize the patient while high-quality medichines go to work.

Most people actually turn to their personal muse to resolve everyday problems and temporary maladies, such as an allergic response to a pollutant in the environment. The muse can identify the problem, determine the appropriate response by cross-referencing data on the mesh with their user's medical history, order whatever is required, and have it nanofabbed or delivered to their user with little to no conscious input. Except for residents in communities without access to modern technology, no one really goes to see the doctor anymore unless the problem is beyond "off-the-shelf" solutions.

Body Banks and Resleeving

Resleeving is both big business and a part of everyday life in most colonies. While areas controlled by the hypercorps almost exclusively operate commercial facilities that require direct payment for their services, some autonomist and cooperative habitats actually have public resleeving facilities that provide access to basic, unmodified morphs. Highly specialized morphs, of course, require more individual resources, some kind of barter arrangement, and/or access to privately owned facilities, but this ensures a minimum standard of living for everyone in the community.

Public resleeving is almost always restricted to citizens to mitigate a mass influx of infugees and prevent the transient population from putting a strain on the system, though wait times have a strong inverse correlation with an individual's standing in the rep economy. Such facilities provide the standard-of-care in terms of maintaining cleanliness, only using certified ego bridges and providing untampered bodies. However, there are no frills. Once an ego integrates with its new body and finishes acclimating, the individual is free to go. On-site psychosurgery facilities are available in the event of the rare emergency, but the public centers do not take responsibility for any non-critical complications.

Gravity is essential to the tissue-development process involved with growing new biomorph clones, which can be a strongly limiting factor on the morphs available on tin can, beehive, and cluster habs. Morph availability on habitats with spin or natural gravity is only constrained by the resources and volume available for the growth chambers or assembly lines.

NANOFABRICATION

Public nanofabricators run off the trash and other wastes generated by a habitat. Anything on the blueprint list that can be made from the recycled materials and does not violate contraband restrictions, such as weapons or volatile chemicals, is available on-demand. For example, many people will change clothes by selecting their new attire from the list and discarding what they have on into the recyclers to cover the cost. Hazardous materials can only be recycled at designated drop points to prevent cross-contamination. Some public fabbers do have the option of expanding the available blueprint list for a nominal fee or the input of additional material by the user.

Access is usually first-come, first-served, though larger jobs that require more system time are automatically scheduled during off-peak hours. The fabber will send the user a notification over the mesh when the project is complete, if it cannot be assembled immediately. Individuals who overuse the public system can find themselves facing fees, based on either the frequency or the scale of their requests, to cover the additional cost of maintenance and upkeep. For most habitats, this serves as an effective deterrent against the free-rider problem.

Nanofabrication of larger items, heavier construction materials, or goods that require exotic or rare elements may not be an option, but most larger habitats have ample robofactories. These robofacs are capable of handling custom design orders, often with a quick turnaround time. Similarly, many nanofabbers are not capable of disassembling large items that can't be broken down or particularly dense objects, so these must be taken to larger disassembly centers for recycling.

POWER

A wide variety of options are available to provide power for habitats, from generators that draw energy from the local environment to immense fusion reactors. However, the selection of a power source is not just about generating current. Factors such as population safety, refueling, structural limitations, environmental limitations, and cost all play significant roles in determining what keeps the lights and life support on.

SOLAR

Solar power remains common in the inner system because the only costs are fabrication and maintenance. Far from the bulky, finicky, and toxic photovoltaics of the early Space Age, panels are now printed in sheets on a composite substrate with integrated micro-scale concentrators that focus up to 90% of the sun's light on each cell. This reduces the size and mass required to generate electricity dramatically. Arrays that were once the size of a playing field are now no bigger than a person. Excess heat rejection is accomplished with capillary tubes circulating coolant from the thermal control system.

Electrodynamic Tethers

Habitats that move through planetary or solar magnetic fields can generate power by extending electrodynamic tethers but require reboosting as they exchange kinetic for electrical energy. Electric potential builds up along the cable as it moves in its orbit through the magnetic field. Skyhooks and rotovators can reduce this process to generate thrust, but stationary space elevators are motionless with respect to the local magnetic field. However, this system requires enough proximity to a local plasma source for electron exchange. In the case of Jupiter, such regions are also home to dangerous radiation belts. Vibrational modes from pendular motion and unexpected surges or discharges from variations in the local field can also make an electrodynamic tether unstable.

Thermal Generators

Thermal generators typically are based on the Stirling engine. A heat source such as a solar mirror or radioactive pellets warms a working fluid, which drives a piston in a linear alternator. The piston, in turn, drives the generator to produce electricity. The remaining heat is rejected to space. Though thermal generators are limited in output by the efficiency of the Stirling engine, they are very robust, provide constant, low levels of power, and can operate for decades. Some pre-Fall probes in the Kuiper Belt are still functioning on these systems with a minimal loss from the steady decay of their radioactive fuel pellets. Thermal generators are also popular with processor loci and as emergency backups. Nuclear batteries are a special variant of the thermal generator and directly convert the heat from radioactive decay into electricity by thermocouples. This is less efficient because of conversion limitations, but more easily miniaturized because there are no moving parts.

Nuclear batteries are a special variant of the thermal generator that converts the products of radioactive decay into electric power. The oldest and least efficient generate power from heat via thermocouples, while modern optoelectric batteries use either photocells tuned to capture IR or betavoltaics that convert captured beta radiation with minimal thermal losses. Some work has been done with converting higher-energy emissions, such as gamma rays, but the risk of backscatter radiation is much higher and requires heavy shielding.

Nuclear Fission

Nuclear fission remains an option on planetary habitats in the inner system, where most radionuclides are concentrated. The most widely used design is the fission fragment reactor. Nanoparticles of fuel are electrostatically suspended in the core, while a magnetic mirror focuses the ionized byproducts of fission into a beam. The surface area of the "dusty plasma" is high enough that radiative cooling is effective on its own. Deceleration of the ion beam provides direct collection of electricity at up to 90% efficiency. During the fuel cycle, the majority of the highly toxic fission byproducts are consumed, such that the final waste only emits alpha particles. These are blocked by biomorph skin, though workers must take care not to inhale or ingest any of the fuel during loading and maintenance.

Nuclear Fusion

Fusion generators reside at the top of the chain because no other system can match their balance of high output, high efficiency, and storable fuel. Deuterium-tritium reactors are both widespread and the oldest generation of the technology because they are the easiest to ignite. The problem with D-T fusion is that the neutron flux is relatively high and power must still be generated by transmitting heat to a working fluid. Over time, the containment vessel will become irradiated and the moving parts in the generator will break down.

Habitats in the outer system solved this problem by mining helium-3 from the atmospheres of the gas giants. Though He-3 fusion has a higher ignition temperature and lower reaction efficiency, the neutron flux is reduced by as much as two-thirds and the average emission is much less energetic. Helium-3 fusion also produces electrons for direct transmission, eliminating a separate generator. As a result, He-3 reactors are smaller and lighter for the same production capacity, though they require a special fuel.

The Planetary Consortium refuses to be dependent on shipments from the Titan Commonwealth, though. The dense plasma focus reactor was originally developed on Titan for researching exotic, low-neutron fuels, but scientists and engineers in the Consortium have perfected it for the deuterium-deuterium reaction. Cycles of electromagnetic acceleration and compression generate plasma that is "pinched" into a state where fusion occurs. As with helium fusion, DPF directly converts the fusion energy into electricity, but at much higher efficiency and with fuel from any source of hydrogen.

Power Transmission

Most power transmission is over low-loss carbon nanotube filaments or fiberoptic cable, unless particular environmental conditions favor metal wire. This allows a habitat to provide power without high voltage lines that present both an electrification and thermal hazard. Fiberoptic lines require the electricity be converted into a laser for transmission. Power can also be transmitted wirelessly by electrodynamic induction or beaming. The induction method is useful at short range for universal charging pads, RFID patches, smartcards, and portable devices. While it is possible for a habitat to install induction coils throughout the volume for constant recharging, this is inefficient unless absolutely required.

Long-distance wireless power transmission, such as from powersats, is done by laser or microwave. The

microwave method has efficiencies on the order of 95%, but requires large transmission and receiving antennas. A 750-megawatt system would require a 1-kilometer diameter transmitter and a 10-kilometer rectenna, for example. Laser transmission can be miniaturized, even to the level of nanosatellites, but loses some efficiency in the conversion process. The receiver is simply a monochromatic solar cell optimized for the laser frequency.

SECURITY

Except for tin can hovels on the edge of the system, widespread surveillance is a fact of life thanks to the nearly uncountable number of small data-gathering devices. Even anarchist and autonomist habitats have the same surveillance and security systems as the hypercorps, Consortium, and the Junta; the difference is in the philosophy and control schemes that govern them.

Spimes are useful because they provide data at nearly any level of granularity a person desires. Though the majority of individuals prefer to filter out data at the conscious level that isn't directly relevant to their interests, most muse software includes automatic subroutines that access local spime data and status updates from Habitat Control to immediately inform the user if a threat presents itself. This is a much faster and more efficient method for getting residents out of harm's way than a centralized alert system. It also gives individual morphs a greater chance of evading harm until the proper authorities respond to the threat, be it a criminal, an environmental hazard, or a structural issue. If carbon dioxide levels are getting dangerously high in a certain area, for example, the local mesh will provide the muse with a constant update of the conditions, allowing a muse to guide its user to safety. If someone is being chased in an alley, their muse can access the mesh to tell authorities which local spimes can view the threat, plot multiple courses to safe areas, and even put a public alert out to draw attention.

Like other habitat systems, many colonies rely on sentry bots and similar AI-piloted robotic guardians to handle routine security measures. Bots are favored over personnel because they follow orders without question and avoid putting an actual ego in danger. Microgravity habitats, especially tin cans, very often rely on drone security because the machines do not impose on their life support margins or create organic waste to be dealt with. Quite often these bots are overseen by infomorph security personnel, who can evaluate if an incident requires more discretion, tact, or overwhelming force than the security bot is applying. These operators can also teleoperate or jam the bot directly, putting themselves in control of the situation.

Aside from standard sentry bots, many habitats employ automech, dwarf, and similar utility robots to handle security threats because they can be used for other tasks when not responding to alerts. Hypercorp habitats are well-known for using this method to save costs in non-essential areas. These bots can also be equipped with standardized packages that vary with the assignment. A "pacification loadout" typically consists of a vortex ring gun or shock baton, a grenade launcher with concussion or overload rounds, and a freezer spray weapon or microwave agonizer. The "assault loadout" trends more towards seeker rifles, explosive mini-grenades, and submachine guns with zero bullets or laser-guidance. Bots can also use whatever tools or equipment they have on hand, though the results can vary. Just the presence of a dwarf bot with mining bores spinning might be enough to scare off a would-be attacker. It might also incite unruly protestors to cry, "Oppression!"

Morph guards are used in habitats where the authorities give the security forces more discretion, a private company provides the services, or drones are distrusted. Olympians and novacrabs are common biomorphs in security, as well as arachnoid and slitheroid synth-shells. These are sometimes equipped with heavier armaments, military armor, or exoskeletons in situations that call for force multipliers. Mil-spec reapers and similar combat morphs are kept on stand-by in case of serious disturbances, dangerous outbreaks, or military assaults. The Jovians are particularly reliant on biomorphs for physical security because they don't trust computers to do all the work and they have a deep disdain for police baboons that "put good men out of work." The average Jovian enforcer is likely to have a shock baton and a pistol with flex or zap bullets. Only higher-ranking officers, corporate security, and military police have the authority to use fully lethal firearms, though most of the Junta's leadership looks the other way if a dissident is outright beaten to death.

Habitats that lack the compunctions of the bioconservatives have also been known to include smart animals in their security apparatus, from smart dogs upgraded with defensive bioware and cybernetics to the dangerous but effective police baboon. Smart rats and mice can also serve as an unobtrusive network of monitors.

SENSOR SYSTEMS

All of the functional systems that make up a habitat rely on either embedded or parallel sensors to function smoothly. Pressure and strain gauge spimes on mechanical systems provide that data that lets the control system know when a pump or seal is going to fail. Infrasound detectors can quickly communicate the presence and intensity of systemic disturbances that may take out local electronic sensors, such as the detonation of an EMP device.

Electromagnetic field meters and magnetometers built into the external structure of the habitat are used to monitor solar weather. They can also be used to detect if an approaching spacecraft isn't everything it seems. For example, there could be a problem if lidar and t-ray scans show a bulk cargo freighter, but the reactor power and EM field are more consistent with heavy directed energy weapons.

BIOSYSTEMS

Biosystem habitats like MeatHab have representations of the major physiological systems in an animal. The biosystem equivalent of an alimentary tract would take raw resources from harvesters through designated orifices, use biomechanical pumps to transfer the water and nutrients to bioreactors that grow the components for other biosystems, and pump whatever excess remains to another set of bioreactors that process internal wastes for recycling. Only toxins and slag that cannot be broken down into something useful would be vented into space at the end of this process.

Some kind of analogue to the endocrine system is also necessary to provide biochemical control over tissue function and metabolism. This is a regulatory network of chemical pathways that tells the biosystems how to perform, whereas the nervous system tells the biosystems what to do and informs the primary control system of the overall functioning of the system. As a result, the endocrine and nervous systems are almost always connected in a feedback loop. For example, the endocrine system can release additional neurotransmitter chemicals into the neural tissue to facilitate increased activity, based on an initial command from the primary controller delivered to the endocrine system by the nervous system.

Regenerative biosystem exterior hulls are very much modeled after the life cycle of skin. The outer layer of cells is engineered to harden and self-seal upon exposure to vacuum and die in place. Exposure to radiation, debris, and micrometeroids will cause this outer layer to ablate away over time and healthy cells grown underneath will take its place. This steadily self-replenishing system can be one of the major drivers of resource harvesting for a biosystems habitat. However, it cannot carry the structural loads of the habitat on its own.

Fixed biosystem hulls are instead derived from arthropod biology and have a silicate exoskeleton with thick carapace-like walls designed to withstand the steady bombardment of the space environment. Repairing damage to such a biosystems hull can be difficult, though, because the completed structure is effectively dead. Some bioengineers think a hybrid system with regenerative walls growing in the spaces of a fixed-hull lattice gives the best of both worlds.

An endoskeleton structure has the advantage of being protected against the elements by the outer skin and can grow with the habitat over time. However, getting the right balance between the flexibility of a cartilage-like network and the strength of bone-like structure can be difficult. Calcium can also be hard to come by in the outer solar system, where biosystems habitats are more accepted. Instead, an injectable compound derived from human bone replacement therapies is excreted from the bioreactors and hardens at ambient temperature. Once set, this flexible composite has a mineral-to-organic ratio compatible with surrounding tissue and strength comparable to structural steel.

Myomers grown from stem cells in the bioreactors provide the motive power for a biosystems habitat. They can be rolled up into biomechanical pumps, laid out over capillary tubes, control orifices that act like hatches and doors, and squeeze biosystems glands that provide food and water for the residents. The musculature must be attached to the primary structure to provide any leverage. Otherwise, the habitat would just be a quivering mass of tissue.

Though many bioengineers will matrix electronic sensors into biosystems in a manner akin to cybernetic modification of a morph, there is growing research into biosensors. Biological transistors can transmit the data from light-sensing cells, chemical receptors, lateral lines, and other bioware directly to the neural network for processing, sometimes with fewer false positives than electronic sensors. ■

Chemical sniffers can be optimized to trigger upon the introduction of a compound that should not be there, such as explosive materials or the exhalations of biomorphs in restricted areas. Rare element scanners are more expensive and specialized, but virtually impossible to beat without enclosing the contraband in an entirely closed-loop environmental system and cleaning the exterior of the container thoroughly to match ambient conditions. Such an apparatus will itself require a strong cover story or masking of its own to get past customs and security.

EXTERNAL SENSORS

External sensors such as lidar scanners, radar arrays, passive T-ray detectors, and IR cameras are often mounted on modular pallets that can be repaired and replaced without requiring a massive overhaul of the habitat structure. These sensor pallets can also be easily distributed over the hull to increase the effective size of an array without necessarily making a bigger target. Large sensor arrays and antenna are only used for very specific purposes, such as wide field detection of galactic gamma ray bursts and military electromagnetic warfare operations (jammers). Smaller sensors arranged into interferometers and partnered with powerful data processing software typically are more than sufficient.

TRANSIT SYSTEMS

Fully enclosed habitats with little open space often rely on elevators and internal rail cars to move

people around. In the case of microgravity habitats, there is little difference between the two in function. Elevators tend to be thought of more for moving people inside buildings and discrete structures, while a tram or train is used for transit across the entire habitat. In habitats with artificial gravity, elevators are associated with moving "vertically" in the direction of the gravity gradient.

Floatways are the lifelines between modules in tin cans and cluster habs. Entirely in microgravity, the walls are designed to carry power connections, fluid transfer tubes, gas hoses, and various other infrastructure lines without blocking personal traffic, internal airflow, or emergency hatches. Automatic linkages at each connection point have valves that simultaneously cut off the flow through the wall lines if the emergency hatches are closed. This ensures that fires, hull breaches, and other hazards can be quickly contained. Early space stations often passed internal lines and hoses through the open hatches, which meant there was not enough time to close the hatch in an emergency because the astronauts had to clear the volume first.

Grab-loop conveyors in floatways and within large hab modules themselves allow morphs in microgravity to quickly get from place to place without expending a lot of energy or risking bumping into people, which often has a cascading effect of bodies ricocheting off each other in a crowded volume. The conveyors follow predetermined routes and entoptics are tuned to the system to provide directions and notification if a transfer to another line is necessary. Within a floatway, grab-loops are self-contained and do not cross the seal at the connection point, so most riders let go at the end and coast to the next line.

Monorail lines can be installed both within the pressurized volume and on the exterior of the hull for rapid transit across the habitat. Many Bernal spheres, Cole Bubbles, and O'Neill cylinders have monorail lines that traverse the rotational axis and along the surface of the habitable area. The trains that transition between the low gravity at the poles and the spun gravity on the interior surface typically have grab loops all over the interior walls and gel couches that a morph can press into to hold still during the change in gravity. Some habitats forgo trains in favor of personal travel pods that run back and forth across the lines. This allows each traveler to adjust the interior to their personal level of comfort and select a route and travel speed of choice.

Many habs with rotational gravity maintain a public bicycle system in the habitable area. Bikes for rent tend to be more common in the inner system, while free bicycle networks are typical in the outer colonies because they are so easily produced by nanofabrication. In either case, bicycles are cheap, provide good exercise, don't pollute the internal environment, and take up little space—especially if a folding bike or urbanized design is used. More people know how to ride a bike than drive a ground vehicle, after the Fall.

HAZARDS

Source: *The Homesteader's Guide*—an official Jovian Republic publication for Reagan cylinder residents [Link]

Everyone knows on an intellectual level that space is a hostile environment. Since our survival depends on conquering the showers of radiation, wide temperature swings, and infinite vacuum, we have a tendency to become complacent or, at least, push the risks to the backs of our minds. For many individuals, a complex web of technology and other people stand between them and the danger. Even in the event of an emergency, most rescue systems are designed to be so simple and so automatic that a child can follow the directions without an adult present.

We in the Republic don't rely on machines to do our thinking for us, though. We face the danger with clear eyes and full vigilance against the unforgiving black. Though the Reagan cylinder is a triumph of engineering, external threats could one day penetrate the armor it provides. You need to know what to expect if the unthinkable should happen. This section of the Guide will help you remember what is important and may just save your life and those of your loved ones in the event of an emergency.

FIRE

Fire is the most common and among the most feared dangers on a habitat because it affects everything. The fire itself uses up vital oxygen and releases soot and toxic compounds into the air. Persistent burning can destroy internal systems and damage structural elements. If left unchecked, a fire can spread quickly from its source, which is always a concern in an enclosed volume.

The easiest way to avoid a fire hazard in everyday life is to keep separation between heat sources and potential fuel, such as trash, clothing, electronics, and food. Inadequately protected cabling is believed to be responsible for sparking the flash fire that killed America's first lunar explorers. Anything that emits fumes should also be extremely well-ventilated. One early cosmonaut died horrifically when he threw an alcohol-soaked cotton swab into the trash near an open Bunsen burner flame and it ignited in the pure oxygen environment.

Immediately report any signs of fire. Initial warning signals are the charcoal smell of smoke, an acrid smell from burning plastic, an unusual mass of hot air, or smoke tendrils. If you locate an open, uncontrolled flame, find the nearest emergency alarm and follow the directions given by Control. In the event of a fire alarm, follow the directions announced by Control or local Republic authorities.

A fire on the Russian Mir station from a failed oxygen generator nearly destroyed an entire module before it was brought under control. However, the burning plastic and metal overwhelmed the

station's primitive environmental control system. The American astronaut on board at the time reportedly could still smell the fire for months afterwards.

Residents who spend time in external microgravity modules should be aware that fire is spherical in shape in microgravity. Such fires also expand more slowly, as they do not draw in as much air as they do in gravity conditions. Many small fires will actually put themselves out if there is a lack of air circulation.

POLLUTION

This brings us to the issue of air pollution. Environmental systems are responsible for keeping the air we breathe clean. If those systems break down or are destroyed, you will need to control your emissions to help keep the air safe for everyone. Most storage containers are designed to absorb the natural off-gassing that occurs with nearly every manufactured material, so put your things away when not using them.

Biological emissions, such as bad breath, evaporated sweat, accumulated dust from skin cells, and flatulence, can be a significant contributor to local air pollution, so keep your body clean. If you notice that the airflow is low or inconsistent and you start to feel ill, move to a new location or call for help. Carbon dioxide from your exhaled breath might be building up to dangerous levels in your area.

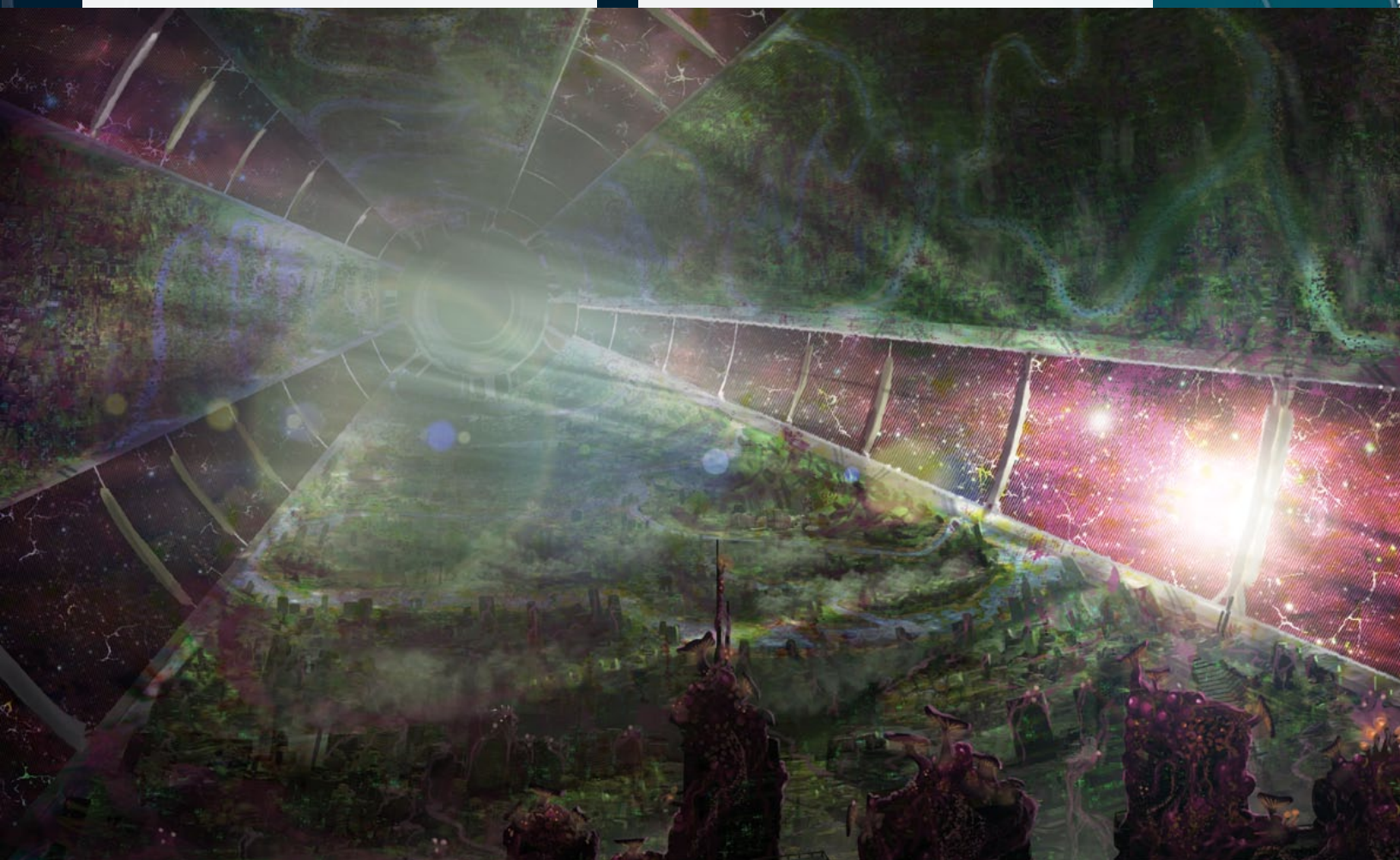
If pollutants in the air and water are allowed to accumulate, the environmental and life support system will eventually be unable to cope and the ambient environment will be increasingly unsafe without personal protection equipment. A habitat is said to be "septic" if levels of toxic materials or the presence of pathogens (bacteria and viruses) that flourish in the poor conditions are high enough to require full environmental gear. If you notice signs that your area is "going septic," it is your civic duty to report what you find to the local Republic authorities.

Look for cloudy or odd-colored water or particles settling out. This might be a sign of a broken filter. If your water pressure is low, immediately report it to Control as this could indicate a pump failure or a major leak. If the plumbing is pressure-fed, wastewater might backflow and cause local contamination. If you detect any sort of sewage in your water, notify Control and request a hazmat flush of your system.

DECOMPRESSION

Thanks to the natural protection of a Reagan cylinder's thick rock walls, decompression is rarely a concern for the main habitat spaces. However, this is something you should keep in mind if you work in the spaceport or a mine near the exterior surface. Decompression is also a plausible threat if a foreign adversary ever attempted to invade the cylinder. As a result, you should always remember the basics on exposure to vacuum.

A slow leak should give you time to put on a spacesuit or oxygen mask and/or evacuate to a



secure location. Be careful if you're working in an area without automatic sensors, though. Hypoxia could settle in and threaten your health if you aren't paying attention. This might result from a broken external seal or a small penetration of the outer hull that does not affect the overall structural strength of the habitat.

Rapid, or "explosive," depressurization is indicative of a more catastrophic structural or systems failure, such as outside attack or impact with a large piece of debris. By whatever cause, the sudden weakening of the pressure containment is overcome by the internal air attempting to equalize with the near-perfect vacuum outside. The suction force may eject you into open space if you are not tethered by a safety line. In an event like this, the affected sections will almost certainly be sealed to prevent further depressurization. Self-rescue may be your best option, if you are sealed out and can find a way to an unaffected airlock before emergency personnel arrive.

DAMAGED HABITATS AND SYSTEMS

Only properly trained and licensed salvage operators are authorized to approach or enter derelict habitats. Some reclamation work of habitats critically damaged or abandoned during the war with the AIs is underway, but strict protocols are in place to prevent a Trojan horse from threatening our people. Even abandoned stations confirmed to be untainted by their presence are still dangerous places. Much of the knowledge gained by the brave salvagers could be useful in an evacuation during enemy attack, so heed their lessons.

Severe structural damage makes for protrusion, debris, and sharp edge hazards to gloves and suits. This is especially true for soft suits and mechanical compression garments. Always be careful where you grab with your hands and move your arms and legs. Many abandoned habitats are also either exposed to vacuum or have unbreathable internal volumes. The interior surfaces might even be covered with vented toxic materials, including chemicals that can degrade suit materials upon contact or warming in sunlight.

Dormant security systems with independent power supplies could perceive entrants as a threat and react accordingly. Damage to their control hardware and/or software would render them unresponsive even to people with the required ident codes or security keys. Scrambled mesh systems can "snow" sensors with junk data or even be used as a vector for attacking perceived intruders.

Damaged power systems are a particularly severe hazard. Never touch an exposed power cable without confirming it is not electrified. Keep in mind that suits with protection against electric shock may not be able to withstand the heat loading from a high voltage line. The greatest dangers from fission power generators are the heated working fluids and the radioactive materials at the core. A breakdown in the power generation loop can vent superheated steam at high pressure. A failure in the cooling loop or containment system, such as from battle damage or a core meltdown, could contaminate the reactor spaces such that specialized suits would be required for safe access. In the event of a catastrophic failure of a fusion reactor, the reacting plasma could be vented like a torch. Also, fusion fuels that emit neutrons during the reaction irradiate the containment shell over time. The destruction of an old fusion reactor could, thus, scatter radioactive metal.

Abandoned habitats that are known to have suffered at the twisted machinations of the TITANS or are suspected of infection are typically sterilized with x-ray lasers and guided into an impact course with Jupiter to ensure no trace of the enemy remains. Entire projects have been lost when a work crew stumbled upon and inadvertently activated a trap left behind. We mourn their loss, but remain thankful the containment procedures continue to work.

If you notice changes in your own behavior or that of the people you know after doing work on a reclamation project, report to Control for a medical evaluation. Anti-social or sociopathic behavior, paranoia, speaking in tongues, and impulsive activity are warning signs. Also watch for inexplicable disorientation, seizures, hallucinations, and chronic nausea. Physical changes can include unusual growths, inhuman body features, skin alterations, and even physiological transformation—all in a matter of hours.

Also monitor your equipment for inexplicable malfunctions or outright subversion. Please report rapid or degenerative changes in people or equipment to Control immediately. If you are self-reporting, assist with the quarantine process. Control will assign you to the nearest rescue zone to limit any infection. Turn off any inserts or portable devices. Do not attempt to re-sync with the mesh. The proper authorities will locate you, secure the site, and provide you with instructions to be followed to the letter and without question. This is for your own safety and that of others.

Sadly, we must also remember that not everyone accepts the truth we have found in the Jovian Republic. Criminals and anarchists alike threaten our stability and security because of our belief in the sanctity of every human life as nature intended. More than a few have attempted to use abandoned habitats as covert bases of operation from which to launch unprovoked attacks on Republic information systems and citizens. Others use derelict stations as waypoints for the trafficking of dangerous and illicit materials, including understandably forbidden TITAN relics. If you come across evidence of subversive activity or identify a criminal outfit in the course of your work, report your findings to the security services without delay. You may just be the next Hero of the Republic.

THE HABITAT IS NOT THE TERRITORY

Posted by: Nadim Saleh, Neo-Situationist

<Info Msg Rep>

We act in the spaces we inhabit and the spaces we inhabit act on us. We shape our environment and our environment shapes us.

Our habitat exists not just as a physical and temporal thing but as a psychological construct infused with memories and assumptions. Through the mesh, our physical space enters our psychic space. Every habitat exists both as a physical thing in physical space and as a kind of memory palace in our information space. We navigate not just by maps and sights, but also by associations. We navigate not by geography alone, but also by psychogeography.

We appreciate our spaces differently when we know what they're made for. Habitats either lack mystery (for we made everything from the shell to the sky) or have mystery selectively applied to them through willful ignorance. We choose not to research the creators of our flats and the architects of our skies because we *want* a sense of an era behind us, we *want* the mystique of a world larger than the routine we inhabit. We want to feel like we can find some beautiful detail to appreciate that is just ours; we don't want to be reminded that every such detail was put there by some designer or nanobot. Not every minute of the damn day, we don't.

Psychogeography is about cultivating an understanding of how an urban space affects an inhabitant—and for our purposes every habitat is an urban space, thanks to issues of overcrowding, economy of space, and public versus personal understanding of communal spaces.

Your job is not just to get the best feeds into your entoptics, not to parse the best data, not to carefully program an exquisite muse, your job is to fucking *think* about what you're being shown, what you're being told, and the choices you make as a result. Why do you walk through that park on your way to the genetics market every day? Why do you avoid the corridors that run under the hospital buildings in your station? Why do you scale the vertical hallways of your microgravity beehive using these rungs and not those?

Don't let designers make all of your decisions for you.

PSYCHOGEOGRAPHIC AWARENESS

In the 20th century, Raoul Vaneigem wrote, "All space is occupied by the enemy. We are living under a permanent curfew. Not just the cops—the geometry," and if it was true then it is more true now, when we're all hedged in, quarantined by geometries designed to keep us alive but also to keep us orderly, docile, routine.

Our habitats are built to resist damage from without and attacks from within, but they are also designed to *deflect* attacks, to channel behaviors, to encourage one kind of attitude and discourage another. Spaces can be designed to awe and inspire or to impose and oppress. It can be as obvious as a locked door or entoptic warning, it can be as subtle as the bend to an avenue or the slope of a corridor. The wide boulevard beneath the landscaped sky of a Cole bubble invites wandering and welcomes strangers, while demonstrating the seemingly invulnerable scale of the habitat. The red, narrow corridor that slopes down out of sight past a nest of waste bins rejects the casual traveler, representing itself as a utilitarian place meant for workers and those who belong.

AR navigation only makes explicit what urban planners and architects have been making intuitive for centuries. Some places invite traffic, some places repel it, some places send out implicit signals coded for polite society, some places are clearly labeled. These e-tags can dominate our perceptions if we let them, enveloping us in mists of information, instructions, warnings, and advertisements. Even when you filter them down, the important security notices will breach your defenses with their alert protocols, telling you explicitly where not to go and what not to do. We become so accustomed to these references, we sometimes don't see the physical strata that lies underneath. Many of us automatically skin over certain aspects of the environment with which we do not wish to be bothered, literally blinding ourselves to our surroundings. For a different experience, walk the same routes with your mesh link turned off, and see the terrain for what it actually is. With your attention free from distraction and censorship, you will see your habitat with new eyes.

With RFID signals and mesh presences, buildings talk to us directly. They tell us their histories, their major features and points of interest. We see the tags left behind by visitors, the reviews, commentary, and graffiti. We see the impact this place has had on people's lives, if we choose to look. Each place has a story to tell, if you take the time to learn it.

They also lie. The advertisements that ping every muse don't just promote a place's marketability, they can also promote its rank and appeal, characterizing a venue and turning a rundown dive frequented by habtechs and miners (exclusive and unwelcoming) into an authentic neighborhood experience (accessible and welcoming). Has the writer of that ad polled the clientèle to see if all those habtechs and miners want fresh young things in their third place? It doesn't matter—the ad has transformed the clientèle into a part of the establishment, at least for those people whose muses let the ad through.

Don't just read the AR tags that come your way, consider who wrote them and why. Whenever you're being directed towards some landmark, you're being directed away from someone's local touchstone. For you, the New York memorial in the torus's Grand Park is the defining feature of the landscape, and the AR backs you up. But to the locals, Grand Park is defined by the spot where the local police found the bodies last year, which they have all flagged and

tagged in an AR feed shared through a neighborhood social network. Same park, different memorials.

Every place is a collection of overlapping layers, and you won't always be able to see all those layers. Remember that what you see isn't necessarily what the person standing next to you is seeing.

DRIFT AND DRIVE

The mesh steers us through space, luring us down the familiar street with the comfortable smells or scaring us off that strange corridor with the purple lights and the foreign stink. When you visit that familiar foreign station in your rented morph, and you take that same, quickest route from download to your favorite noodle shop, you're a slave to the geometry of your habitat. You didn't really arrive at a choice of routes, you just accepted the route that's easiest, labeled the fastest, that would get you through the station's urban plan as quickly as possible. That's a dodge—that's you dodging the cityscape as much as utilizing it, minimizing the time you spend in the space between your familiar locations.

Sometimes it's the smart choice, to submit to the flow and geometry of the city and let it carry you, but you need to know how to break free of that, too, and travel and explore. You need to be able to both drift and drive.

When you wander a space, following inputs from open mesh signals or AR markers, pursuing the smell of burnt curry or the sound of a damaged piano, investigating whatever the habitat has to show, you're drifting. It's a valuable way to discover a place's inherent character, to learn not what a place says it's like in its Solarchive entry and travel blogs, but what a place is actually like.

When you move through a space with purpose, whether that purpose is to blend in with the obedient traffic or to defy constrictions and blow through barricades, you're driving. It's how you exert pressure on a place, either by bending it at the joints or forcing it to break. Sometimes you'll want to sink into the flow of the place, and sometimes you'll want to cut across the perpendicular.

Exploration and interaction with a space in new ways—by succumbing to its geometry and flow—are psychogeographic performances. Freerunning and urban exploration are major examples, both of which you might find yourself doing in your career, albeit with intent and motives that don't really count as sport. Both exercises are ways to grab a habitat with both hands and master it, by redefining what's accessible, by seeing what can be seen, not just what's on display.

Freerunning, of course, is useful if you find yourself in pursuit or being pursued, if only because it makes you unpredictable. The person who can grok a space the fastest wins.

Urban exploration—that is, in the overcrowded realm of the universe's young habitats, trespassing—is useful for fact-finding. Firewall agents from Mercury to Pluto have reported forgotten spaces in habitats otherwise choking from overcrowding. Every station has its place that, if not abandoned, is at least empty. Since everything in a modern habitat is adjacent to *something*, these empty areas are often useful for gaining access to otherwise restricted areas.

EXOHABITATION

Every habitat is a bubble of denial, a refutation of environmental facts, a statement that we *can* survive even after the umbilical to Earth has been cut. We dwell in places that humanity wasn't evolved to handle, and we've adapted. In a way, we're all refugees. We live in exohabitats and engineered morphs meant to combat a universe that doesn't want us, but what does exo even mean when there is no home world to go back to?

Habitats are designed to make the experience of life without an Earth seem less daunting, less frightening, less alien. Already, the next generation of transhumanity is growing up to find existence in space to be the new normal. Instead, whatever approach the habitat designers have taken to combat the surreality of permanent existence amid the stars is simply the way things are *at home*. Even me, saying this to you, may come across as ridiculous. Maybe you find life in Nova York's needle-like buildings normal, and my nostalgia for Earthly life sees antiquated.

In my experience, habitat designers follow one of three different philosophies when combating the alien experience of exohabitation:

First, the routine makes the alien less alien. Habitats built with this philosophy in mind rely on urban planning notions and Earth-like cityscapes for their designs. They tend to be large habitats with parks and "open air" areas, even if the sun is actually a spindle of hyper-bright lamps and the sky is a series of enormous portholes looking out onto the hub of the torus. At least there's a sky instead of a ceiling. At least the habitat feels as familiar as a city and gravity feel. Traces of the familiar evoke a comfortable nostalgia which inhabitants wrap themselves in.

Second, embrace the alien. Smaller habitats and microgravity habitats are more likely to follow this philosophy. Nova York is a good example, in fact: it's beautiful, it's functional, and it's utterly unearthly. Inhabitants there either adopt an appreciation for the adventure of the new existence … or they distract themselves with it. That frontier adventure spirit is vital for gatecrashers and extrasolar colonials, too, but don't let anyone tell you it's built in. I've seen people gain that spirit and I've seen people lose it. You have to cultivate it, wear it, and take care of it. Without that sense of adventure, alien habitats—by whatever definition of "alien" works for you—can wear you down.

Third, function is everything. No small number of habitats are built to serve a functional purpose beyond habitation, be they Martian mining facilities or orbital churches. These places are built to

serve, and the people who live there see themselves as being at work all the time. Every space has its designated function and is best used for that function. Dormitories are just places to sleep. The mess is for eating, not playing games. Often, the people who dwell in such places are either trapped (sometimes by denial) or waiting for something to happen—a new planet to be discovered, Earth to be saved, their tour of duty to be up, a sign from God. Something. It's what keeps them from the kind of habitats that pursue the first two philosophies, I think.

Changing Needs and Purposes

Almost all habitats, especially the larger ones, start with a particular idea and design. They are planned out thoroughly, every meter of space measured out and its utility analyzed. Each level, each module, each corridor has a purpose, designed to fit or shape the needs of the inhabitants.

If you are old enough, you most likely remember the cities of Earth—the urban sprawls with their gleaming skyrakers and blighted slums. Compare those memories to the colony around you. Note the differences. Our needs have changed, and the purpose of our manufactured environments have changed with them.

Our residences have become smaller. Where once we had suburban homes and condos, we now have cramped closets. Space is limited and overcrowded, so personal dwellings are small and spartan affairs. As our personal and private spaces have shrunk, the need for more common space has grown. When you have no room to socialize at home with your friends and peers, it is necessary to do so in public and commercial areas instead. Social and night-life areas of habitats are typically crowded and busy, as there are few alternatives.

Massive structures are a thing of the past. Most stations have no need for massive buildings—after all, they essentially are one. Except for the vast open realms of some spheres, cylinders, and toruses, there is no place to put a towering skyscraper, mall, or stadium. Even where there is space, there is rarely need. Gone are the megacorps and vast corporations with their need of centralized operational hives and office towers. Most hypercorps are smaller, mobile, and asset light. They do not have vast armies of employees for which to provide workstations, they have deep networks of freelancers on call at any time, able to work from wherever they are. Gone also are the need for massive department stores, malls, and shopping centers, replaced by the ubiquitous nanofabber, the capability to acquire whatever you need online, and small boutique shops that provide customized shopping experiences for discerning customers. Gone too are the coliseums for tribalized sports franchises, erased by the ability to remotely experience sports events as if you were present.

Many structures no longer have specific functions. They are now modular or reconfigurable. A habitat section needed for living quarters one week may be transformed into a small conference center the next and a bazaar the week after that. Smart materials, quick nanofab or robofac construction, and servitor bots mean that it is quick to redesign a portion of a habitat for whatever purpose is currently needed. In habitats with open space, modular structures can be erected and dismantled overnight, or simply moved to more convenient locations. Even the furnishings are rapidly replaceable and recyclable.

Speaking of design, the economic incentives to build structurally and aesthetically identical buildings are no longer in effect. The ability to model structures thoroughly with software and the capability to nanomanufacture or order custom autofactory-made components means that every building can be built according to personalized tastes and specific needs. Even buildings that start with the same rough basic blueprint are likely to come out looking much different once they have been modified for the user. This means that many structures also have a very organic look and feel, with few straight lines and sharp corners and no wasted space.

Unless you reside on Mars or Titan, the ribbons of highways are also forgotten. With no need or space for ground vehicles, "traffic" is a thing of the past. Places that do have roads are graced with the pragmatic utilitarianism of grid layouts, rather than the winding lanes of old that arise organically over time, as usage dictates. It is difficult, in fact, to get lost, even if one means to do so. The roads are also narrower, more friendly to pedestrians. Parking lots are all but extinct.

A new travel way has appeared, one not meant for you and I. Our robotic servants have grown so useful and so numerous that we have devised means and paths for them to travel outside of our own routes. Hidden in the walls and under our corridors are kilometers of thoroughfares just large enough for servitor bots to pass through, hooked on magnetic rail cars or similar devices. Along with their storage racks, closets, and maintenance areas, our things have their own spaces, their own homes and streets, hidden from ours. Because so few of us pass through these areas, they are less surveilled—something those who desire discretion should keep in mind.

Where new paths open, others close. Look around you, you'll see walls. Almost every residence belonging to transhumanity is now walled in. Protected. Limited. Isolated. And the walls do not stop there. Barriers are also used to divide our populations internally. The residences of the clanking masses are very carefully walled off from the rest of us. Note how the thoroughfares from the roboghettos loop around back on themselves, subtly encouraging those shells that try to leave to stay where they belong. The opulent dwellings of the elite are similarly segmented away. These are intentionally hard-to-reach. Checkpoints are common. If you do not know the way, if you are not of their kind, the oligarchs and their kind do not want you trodding their pathways.

Despite these designs, transhumanity has a way of making its own uses for things. Overcrowding may mean that utility tunnels soon become hastily constructed residences. External areas, littered with heat vents and antenna, may be occupied by synthmorphs with no need for amenities except simple shelters from solar radiation. Dome habitats on Mars develop rings of unplanned souks, inhabited by rusters and clanking masses. Abandoned areas are seized by squatters for whatever purposes they need. Common areas draw vendors, who draw the curious and more vendors, and soon a thriving gray market bazaar is born. Clusters are reconfigured over neighborly disputes, to add new modules, or by residents who are simply bored and want a change. As desires shift, so too do our habitats.

PSYCHOVIDEOGRAPHY

Surveillance serves not just as a legal and historical record but as a record of rep: proof that you've done what you say you've done. You bark, and anyone on the mesh can search to see if you also bite. It's the foundation of the reputation economy.

It's not just video, of course, but surveillance of all types. Ubiquitous, ever-present surveillance has become the new public record in countless habitats. You've seen the phrase, "Links or didn't happen," right? Without footage as validation, events almost cease to count. Without evidence, without the perusal and approval of the public eye, events almost do not matter. It doesn't matter how cute your kid is unless he's cute on the mesh or in the flesh. If a body falls in the habitat but there's no audio record, did it make a sound?

Anecdotes have lost all value. The video clip is king, and his throne is shared on the mesh. Reigns are short and full of strife, but the dynasty has been intact since the beginning of the 21st century, when people gladly started trading privacy for doses of recognition from the surveillance society. To kiss the king's ring.

The authority of the king over the surveilled society is total, but his rule is not absolute. Surveillance is here, it is just not evenly distributed. And in the reputation economy, lower-surveillance places are extremist places.

Typically, low surveillance means a poorer district, a place where nobody cares what happens or where what happens doesn't matter so much. It sounds insulting because it is. "Low surveillance" in these places means isolation. It means a lack of social validation. It means no currency to trade for recognition or rep. You can brag about what you did in a low-surveillance area, but without trust to back it up, it doesn't go on your video résumé.

Or low-surveillance areas are extreme in the other direction: highly expensive. "Low-surveillance," in these cases, means privacy. And privacy is a vestigial remnant of the scarcity economy—rare enough that it's worth paying for. Opting out of an economy has always been very expensive, costing either a lot of currency (like spending cash to get away to a

tropical island, back when that was possible) or a lot of capital (like giving up personal possessions and social ties to live off the grid, back when that was possible). Opting out of the reputation economy by leaving lenses behind is just as expensive. Either you bail on the whole system and go to live in some low-surveillance habitat where safety sensors only monitor essential systems like environmental conditions, or you step away temporarily by renting or making a space free of surveillance so you can do whatever it is that you don't want others knowing about.

What's weird about this, at least to the generation that was born on Earth, is that so few people worry about surveillance. Without a militant police state to back it up, the risk of some shame isn't enough to get people upset about the monitoring systems that protect them from cold space or cold-blooded killers. They're trading some of their privacy for security, swapping pictures of themselves picking their nose for the promise that terrorists and spies from other habitats will get photographed in turn.

Again, the barrier between the monitored and the monitors, the known and the knowing, reveals the kind of trust that's necessary to keep a habitat in operation. Some hypercorp security agent or habitat cop might be laughing at you spilling your coffee on yourself or your bungled attempt to hit on that hot sylph at the bar, but at least they're not doing it to your face. Your mockery becomes part of the invisible systems that make the torus turn and the oxygen flow. You get to breathe air in exchange for living in a flat with a window facing a camera. It's just another tax.

That is … in a big enough habitat.

In smaller habitats, surveillance erodes anonymity in a hurry. Instead of being just another face on a mesh video-clip playlist, you're a known figure in the mesh's darling favorite clip that week. You're likely to get spotted on the street or singled out by facial recognition software and fed into an AR routine. Neighbors can go from watching you wipe out as you come out of that gravity transition zone to learning where your cubby is and sending you a mocking message, muse be damned.

What's stopping them? Boredom. That hilarious clip is just a distraction and so are you. It's just more data in a tide of information. So you got your heart broken on camera? So did a hundred other people. It's not news anymore.

This won't protect you from a little ridicule—the rumor-mongering and finger-pointing that come with surveillance and search engines is never going away—but it also sort of resembles summer camp, if you've ever heard of that. There's a gauntlet to go through, some growing up to be done, but the hurt becomes a sting and the sting becomes something you hardly feel anymore.

In the surveillance society, your day-to-day is just not that interesting to most strangers. You're just not worth much more than 90 seconds and a laugh. What you do is available to everyone but known only to those who care enough to search for you, to sift for you, to find and rescue your past self from all the collected data.

That, as a Firewall agent, is your greatest boon. Use the background noise of overwhelming data as your cover whenever you can. Blending in can be as effective as dodging surveillance. Sometimes it's your only option.

Living in Risk

Every habitat is in jeopardy. Every habitat is a city under lockdown. Every habitat is fighting a daily battle against the chill of Europan seawater, the pull of Venusian gravity, or the void of space. This is why so many habitats feel a little like a city in wartime—peaceful maybe on the surface, quiet in the streets, but ready to bristle and always on the lookout.

Many habitats are like walled cities, meant to be familiar to locals and carefully constructed to create a divide between public-friendly spaces and off-limits zones. AR telemetry guides visitors—to the habitat, to the neighborhood, to the smallest sector—to visitor-friendly locations, mediating the experience and cultivating an impression of the place. This is a way of organizing traffic, but it's also a way of organizing behavior and detecting dangers. Some station sensors monitor people's movements and detect deviations from normal patterns. Some habitats tag all rental morphs and track them for the duration of an ego's visit. The habitat itself regards the outsider as a foreign body, because any potential enemy is a risk to the whole city, potentially carrying peril in the form of bombs, contagions, ideas.

The surveillance, the barricades, the AR data recommending this place and forbidding that one, all evoke a kind of "fortress urbanism," turning the habitat into a maze that's navigable when familiar but sturdy and suspicious at the same time. The city is not merely encased in a ring of steel, it *is* the ring of steel. It is walled in on all sides, controlled and constricted, and wary of the tiny foe that could bring it down. A living castle.

Habitation in such an environment is, so often, a pact with the powers-that-be to trade freedom for security. Everyone's freedom is restricted so that no one has the freedom to puncture the city wall and end it all. A hostile environment is, after all, the finest collaborator and enemy could ask for.

The perils of life suspended in poison, or spinning in circles in a hungry vacuum, are constant—there is no weather to it. Every day the risk is real and the same. That is what makes it bearable. Eventually, you just get tired of the fear. You remember how scared you were that some rogue asteroid or bomb-wielding maniac would blow out whatever habitat you live in? Like grief, it gets a little easier every day, until you acclimate. It just becomes part of the uncontrollable pressure of existence. You wake up thankful for a pressurized sky and a cortical stack and you go to work.

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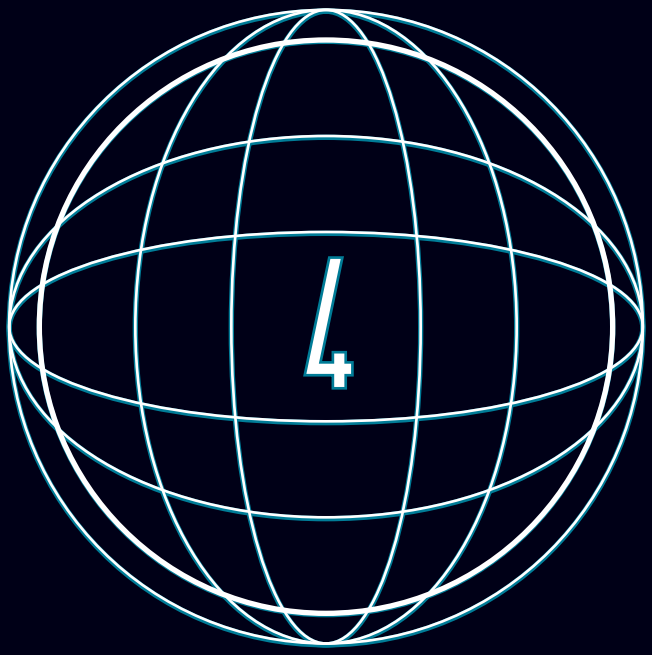
UPLIFTS



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I guess I might as well begin with my name. For the sake of simplicity, I go by Blue. You wouldn't be able to pronounce the whistles and clicks that make up my *real* name. Hell, with the splicer morph I wear nowadays, neither can I.

I began life as an uplifted common dolphin, but it's been many years since I've been that—at least on the outside. (Of course, I'm still an uplift on the inside. You can take the transhuman out of the dolphin, but you can't take the dolphin out of the transhuman.)

I escaped the Fall as an infomorph and ended up as an indent—at least until I found a way to indulge my more, ah, *entrepreneurial* impulses. I have no moral qualms about smuggling—my current line of work. Maybe it's because my species was engineered into existence or how I spent decades of my life as a good corporate servant, but I've developed a strong aversion to following the rules. Turns out it's a lot more fun ripping off the hypercorps than being their plaything.

I like my life, but there are still times late at night when I can't sleep.

Times when I remember the sea.

I miss the freedom. The *speed*. Racing the waves, leaping, the sun warm on my slick back, plunging into the cool water, the ocean going on forever, the bodies of my pod pressing against me …

Anyway, I've been hired to put together a short overview of uplift culture. Hired by whom, you might ask? That's an excellent question. They tell me they're a think tank.

Right.

If I think anything about think tanks, it's that none of them are smart enough to hire the likes of me. The type of information I have to provide is somewhat more *pragmatic* and reality-based than the slurry stuffed inside your average academic paper. Since this so-called "think tank" was clever enough to get the story of uplifts straight from the dolphin's mouth (don't even get me started on horses), I figure I will be polite enough not to ask too many questions, despite the weird vibes. I have an inkling this project is for the greater good. Thank Darwin for intuition.

WHAT IS UPLIFT?

What is uplift? In the simplest sense it's the process of elevating an animal species to sapience. Take a biological creature shaped by millions of years of evolution (the baseline species) and re-engineer it to walk and talk and use tools and *think*. Just like *Homo sapiens*. It's the process of going from sentience (the self-awareness that most animals possess, including feeling, perceiving, and suffering) to sapience (actual thinking and acting with intelligence, judgment, and wisdom). It's artificially accelerated and proactive evolution. It's a biological upgrade. It's turning beasts into *persons*. That's uplift.

Uplift is not a simple process. It's not taking a specific animal and doing something to it to make it intelligent. It's a generations-long process of genetic manipulation, selective breeding, and transgenic alteration. It's a litany of experiments, mistakes, and victories, with living beings as the test subjects.

PLAYING GOD

The active pursuit of uplift really took hold as a scientific field during the great flowering of transhuman culture, an era that also gave us the widespread settlement of space, extensive human genetic modification, nanotech, cognitive science, and the digital emulation of consciousness. It is in fact the convergence of these fields, and the feedback loops spawned between them, that enabled the uplift project to make so much headway so quickly.

It's easy to see uplift as a breathtaking cultural and technological revolution, but the truth is the idea at the heart of uplift is as old as *Homo sapiens* itself. One doesn't have to look too hard to find the seeds of the future being sown in the distant past.

It began in small ways. The first men who lured hungry wolves into the circle of firelight with scraps of meat. The cultivation of wheat and corn, barley and rice. The domestication of cattle and swine, sheep and poultry. The breeding of canines, equines, and other animals into a thousand different shapes for a thousand different chores. And then, as if controlling the sex lives of the world's flora and fauna wasn't enough, reaching into the very genetic repository of the planet and re-engineering it for the pleasure of humanity. Plants first. Then animals. And finally, mankind itself.

The history of civilization is merely the history of humanity bending living things to its will. Control. That's what a human *is*. Uplift is merely the logical extension of millions of years of "progress."

So once humanity had the technological tools to investigate and pursue uplifting in earnest, there was no reason to pause. Despite its many achievements, if there is one thing humanity is terrible at, it is *foresight*. There was relatively little discussion and debate about the consequences or ethics of uplifting animals, at least in the public sphere. The momentum of progress made uplift all but inevitable.

It started innocently enough, as part of the wider project to understand cognition and cognitive development. Obviously, for all but the most unscrupulous of researchers, actual research on human subjects was off limits. But animals, animals

were always there to stand in for humans in experiments. As humans sought to make smarter humans, to better understand the mind, and to measure the impact of implants, biological brain enhancements, and nootropic drugs, one of their first steps was to make smarter animals. The more similar a brain was to that of a human, the better the effects of experiments on such organs could be correlated to humans, and so animal minds were gengineered and modified to be more like human minds. Likewise, efforts to clone and genetically modify humans were first perfected on animals. It was animal test subjects who reaped the benefits of enhanced vision, longevity, and a myriad of other genetic improvements long before humans did—at least until they were vivisected and studied.

As numerous creatures were sent to scout the path of accelerated evolution ahead of humans, it was only natural that some scientists would turn their attention towards improving animals' minds and bodies specifically. For some, this was just an attempt to solve the next scientific puzzle, to see what could be done for the sake of learning and doing it. For others, it was to breed better companions and servants. For most, however, the glory of creating another intelligent species was an achievement for which they could not avoid striving. The allure of playing god was too strong to avoid.

An Ethical Imperative?

As corporate scientists worked in their labs, sculpting animal genes and animal minds, a fierce debate erupted over the wisdom of uplift. Not whether it could be done, but whether it *should*.

The primates and cetaceans already seemed to stand on the threshold of sapience. Chimpanzees fashioned tools to fish for termites and passed this skill on to their young. Whales and dolphins communicated using a system of whistles and clicks that approached language in its level of complexity and also seemed to use unique whistle identifiers for themselves, much like names. Gorillas were taught to speak using American Sign Language and demonstrated mental flexibility by creating compound words. Bonobos mastered language using touch screens and voice synthesizers. How much farther would these creatures really need to go before they became fully sapient?

How could humanity not help these creatures take the final step towards intelligence, many argued. These scientists made the point that sapience was a gift, that uplift would give animals the capabilities to care for themselves more fully, to be more in control of their own future. They argued that humanity as a species had an ethical duty to improve the lot of the world's creatures, to improve the quality of their lives and to lessen suffering.

Their opponents sneered. The movement against uplift was an odd coalition of animal rights activists, opposed to the use of animals as test subjects, and religious fundamentalists, who saw this as an attempt to spit in the face of God. Both factions considered it a perversion of nature, an example of technology driving unspeakable atrocities and crimes. The arguments made by scientists that they were acting in the best interests of these animal species was compared to the ugly rationalizations of colonialism, in which millions of indigenous people were slaughtered and forcibly assimilated into a foreign culture, all for "their own good." The detractors believed that humanity had no right to interfere with another species' development, to make decisions on their behalf, or to uplift without consent. Others feared the taint that uplifts would spread by mixing their animal ways into human affairs.

How could a creature without the means to comprehend the choice before it offer its consent?

The supporters of uplift argued that the idea of consent was a red herring. No human being walking the face of the planet had ever agreed to be born. Why should uplifted beings be held to a higher moral standard? Ethically, others could make the choice for the soon-to-be-uplift, assuming they had the best interests of the uplifts in mind. And for those not won over by those arguments, consent could be obtained retroactively. The uplifts could be asked *after* they'd been raised up.

As it turned out, opinions on sapience were as diverse among the early uplifts as they were among the human population. A few were horrified to find they'd been kidnapped from the Garden of Eden and stripped of their innocence. Most were grateful to humanity for their sapience or considered it a fait accompli. Then there were those with a more nuanced view, thankful to be uplifted, but disliking that human ethics, culture, and modes of thinking were so strongly imprinted on their kind. These mercurials argued that uplifts should have control over their development and that higher emphasis should be placed on each species' own *non-human* path.

Aside from all of these opinions, both pro and con, there was one other major viewpoint. This group regarded *Homo sapiens* as only one thread in the great tapestry of life. In their view, humanity was not the manor lord, doling out gifts out of some virtuous duty to its intellectual inferiors. Instead, humanity was just one species building friendships and alliances with the creatures with which it shared the Earth. This is the promise of what transhumanity could be, a civilization employing the gifts of its many varied members for the betterment of all. Humans and uplifts were not parents and children, but siblings and companions.

Fortunately or unfortunately, depending on your point of view, corporations as institutions are remarkably immune to moral quandaries. While the ethical issues raged through the human zeitgeist, the scientists cheerfully went about their business. So, love us or hate us, it really doesn't matter. We uplifts are here to stay. If you don't like that, blame your fellow humans.

HOW IT CAME TO BE

The first dedicated work on uplift began a half century before the Fall. All of the world's major biotech corporations—Monsanto, Syngenta, Dupont, JingMei, Dow, etc.—had divisions or subsidiaries that competed to make new breakthroughs. But as everyone knows, it was an up-and-coming hypercorp that scored the big prize: Somatek. Led by a brilliant and ambitious young vice president named Rael Duvalier, their efforts paid off. In 38 BF, the first chimpanzee passed the Applied Sapience Test. Jumbles became a household name. Duvalier rode his project's success all the way to the Somatek boardroom.

Over the next two decades, Somatek and their many competitors uplifted eight new species: bonobos, orangutans, gorillas, bottlenose dolphins, humpback whales, belugas, and the first non-mammals, gray parrots and ravens. These developments were not embraced by all of humanity. Anti-uplift groups ramped up their lobbying and protests, with extremists raiding labs to destroy experiments or liberate test subjects. Some governments refused to recognize uplifts as legal persons, while others clamped down on or criminalized uplift research. Aggressive hypercorps that did not wish to see their efforts hindered transferred their projects offworld, outside of Earth-bound jurisdictions and international laws and codes of conduct. Somatek's R&D facility on Luna, Clever Hands, became a focal point for unrestricted experimentation.

Out in the quiet of space, there was no one to see or object to projects that would have raised even more hackles on Earth. Neo-pigs were created, crossing a line many felt should have been left alone, elevating a former food animal to an intelligent being of equal status. Another company, New Day, brought neanderthals back to life—resurrecting one of humanity's nearest cousins, long ago driven extinct at human hands. Other experiments were waged in the hidden recesses of the solar system by people who may not have had massive R&D budgets but did possess creativity and networked expertise. In the decades before the Fall, the first invertebrate (the octopus) was uplifted to sapience, joined by orcas, porpoises, elephants, and other species of dolphins and whales. Dozens of less intelligent species were raised in cognitive abilities, if not full sapience. There may even have been other successes, but then the TITANs smashed the Earth on their way to the singularity. It is rumored that elephants joined the uplift ranks only to go extinct during the Fall.

BABY'S FIRST WORDS

[Begin Transcript]

[A wizened, old chimpanzee male sits in a chair, his clear brown eyes staring off into the distance. His once-dark fur is specked with silver, making it look gray. He looks sharp in a gray suit. He sits up straight and there is intelligence in his eyes. Clearly this is a proud creature—but he's also something else. Sad.]

"I know that many uplifts consider the name Jumbles an insult. And sure, I get their point. It's human and it's demeaning. A circus name—that's what some mercurials call it. But what else am I supposed to call myself? I could take an African name, but that wouldn't be any less human than Jumbles, would it? Do the mercurials really want me to call myself Uplift Pan Trog Subject 119? That was my official name during the project. It may not be as whimsical as Jumbles, but I think it's hard to argue that it's any less demeaning."

[His voice grows softer.] "Jumbles is what my mother called me. Not my real mother, of course. Not my biological mother, as if the concept of biological means a damn thing any more. Her name was Dr. Katherine Santos and she loved me. She was the one that helped me escape, helped me smuggle out these clips. And she didn't call me 'Chimp' or 'Subject' or 'One-Nineteen.' She called me 'Jumbles.'

"That's good enough for me."

[A juvenile chimpanzee sits on a sun-drenched floor, playing with brightly colored blocks. He stacks bright-red rectangles and yellow triangles and blue circles, constructing a building out of primary colors. He is about the size of a human preschooler. He works intently with the blocks. They are obviously his whole universe.]

An offscreen voice (male) says, "What are we seeing here?" The voice sounds human, but really, who can say?

"Everything at the project was documented. Somatek took no chance that a breakthrough might escape them because they weren't watching. There's millions of hours of digital recordings. This is me, age four. On what was almost the last day of my life."

Another offscreen male voice, different from the first, says: "Look, Kathy, he's still not talking."

A woman's voice, now. She's angry. Furious. But despite that, she's pleading. "That doesn't mean he has no value."

"Of course he has value. The modifications to the language center clearly didn't work as expected. We have a chance to find out why."

[The chimp continues to play with his blocks, oblivious to the two humans standing over him.]

"So that's it," she says bitterly. "You vivisect him and poke around in his mind. So you can see where you fucked up?"

"One-Nineteen is a test subject, Dr. Santos," says the man in a voice that is arctic cold. "Perhaps you have lost your objectivity."

"One-Nineteen is a living creature easily twice as smart as any baseline," the woman snaps. "And, by the way, his name isn't One-Nineteen. It's Jumbles."

[Suddenly the little chimpanzee looks up, peers up at the humans standing over him.] "I Jumbles, Mamma. I Jumbles."

"The first words spoken aloud by a chimpanzee," says Jumbles (the here Jumbles, the now Jumbles.) "The first words spoken by a chimpanzee—and the words that saved my life."

[End Transcript]

Uplifts in general fared poorly during the Fall. Many were not given an option to evacuate Earth, even as infugees—human bodies and minds took preference. Not a single neo-elephant escaped the devastation of Earth, not even as an infomorph. Only a handful of neo-whales survived, joining the dozens of their species raised in the depths of Europa, Ceres, and the solar corona. For the most part, uplifts owe their current population figures to the fact that so much uplift research had been forced offworld before the apocalypse.

After just over half a century of being brought into existence, uplifts have diffused throughout the solar system, becoming a recognizable element of transhuman culture. Many still work as indentures, while others are practically enslaved by the hypercorps that created them, working as contract labor for specialized tasks with open-ended (read: eternal) durations. More recently, there have been several waves of emancipated uplifts leaving the hypercorps behind and emigrating to the moons and habitats of the outer system.

Transhuman civilization harbors incredible diversity. Refugees who fled the Fall as *software*. Near-immortal minds uploaded into morphs of any shape or size that can be imagined. Creatures that bask in the blazing sun or frolic in the deep icy oceans of Europa. Bouncers that deftly traverse microgravity modules. Brinkers in synthetic shells who eschew habitats to hide in the dark of the deep system.

In this mix, uplifts are mostly just regular folks. We have the same dreams and needs as anyone else. We need food and shelter. We value fulfilling work and creativity. We want a future for our children. We seek to grow and learn as thinking beings. Despite the bigots, we uplifts are just as transhuman, as *transbiological*, as the rest of you. There's no place we can't live, no job we can't do, no aspect of transhuman civilization we're not part of.

Except not everyone accepts that we are *people*. In most of the solar system, our rights are limited. We are denied jobs, treated as monsters, pets, or slaves, and not allowed to have children on our own. And even though *Homo sapiens* has reshaped our brains, in the end our minds still aren't entirely *human*.

On one end, uplift is viewed as Michelangelo's Adam reaching out to touch the hand of God. On the other, it is Frankenstein's Monster, a horribly misguided experiment and a cautionary tale of the horrors scientific genius can produce. The truth, of course, is somewhere gray and fuzzy in between. Uplifts have the best qualities and traits humans do. Humans have imprinted upon them, but uplifts also bring their own strengths and weaknesses to the table. They exist without ever knowing what it would have been like to evolve to sapience on their own, as humans did. Without ever developing their own modes of thinking, their own unique form of intelligence.

Did humans do uplifts a favor? Or did they erase their potential?

THE SCIENCE OF UPLIFT

So now you've seen how we got to this point and what poor benighted animals humanity decided to gift with its godlike touch, but how was it done? The biology of uplift isn't as simple as just making the baseline critter more like a human; a lot of the things that work well for Homo saps just don't translate as well over to other species. Keep in mind the idea is to create a viable dolphin, octopus, or crow that can think like a Homo sap, not just a human that happens to be wearing a different body.

THE BRAIN

The starting place for all of this work is, of course, the *human* brain. Partly this is because humanity is recasting these creatures in its own image, but also because the human cerebrum is the most thoroughly described higher-order brain available to uplift engineers.

One of the early debates among uplift researchers was whether to steer animal brain enhancement along its likely evolutionary path, thus making them more intelligent without making them quite so distinctly human, or whether to manipulate their brains to emulate humans, and thus produce more human-like intelligence. In the end, it may have been simplicity that won out. Most animal brains were simply not as thoroughly understood as human minds, and it was easier to modify them towards known structures and functions than to try to break ground with distinctly different types of intelligence. (This isn't to say that research into uplift via non-human brain enhancement was ever discarded—it is most certainly still underway, though decades behind. Given the fear of non-human minds spawned by the TITANs, however, such projects are almost certainly secretive and hidden.)

In the early days of uplift, animal brains were modified surgically and with drugs. Uplift engineers grafted on neural clusters for abstract reasoning and language or attempted to boost cognitive capabilities with complex drug compounds. Some creatures were subjected to dozens, even hundreds of surgeries. The real early advancements, however, were made with genetic engineering, sequencing the animal's genetic code and then splicing in transgenic alterations to produce proteins and neuroanatomical formations found in human brains. This process was slow and difficult as it required a nearly perfect understanding of the creature's brain structure, genetic code, physiological behavior, and gestational characteristics, and the full impact of the changes required years of growth to measure. Simply slapping some human neurological traits in was not quite so easy, as those traits had to be assimilated into the animal brain's architecture in a functional manner. As the human understanding of cognitive science and AI developed, however, scientists were able to create more advanced neurological models, cutting down the the number of failed experiments. Nanotechnology allowed

even further inroads, and soon uplift engineers were making their changes much less invasively, neuron by neuron, or rewriting a subject's genetic code in specially modified research healing vats.

Most modern uplift brains rely heavily on transgenic features copied from humans. These enhancements do more than just increase neural networks for metacognition and creativity, boost the information processing capabilities and executive functions of the prefrontal cortex, and modify the behavioral and reasoning structures of the neocortex, to name just a few of the myriad brain manipulations used to uplift to sapience. They also modify the limbic system and hormone levels to mimic human emotional responses and adapt the brain to any physiological modifications accrued with uplift, such as walking upright or tool manipulation with fine digits.

Despite years of research and many breakthroughs with uplift neuroscience, the fact is that the brains of the various uplifted species among us are still not as well understood as human brains—and that's saying something. The simple lack of a complete understanding of neuroanatomy and function that makes psychosurgery a risky affair hinders uplift as well. Brains are messy, complex, intricate organs, and it remains difficult to pinpoint exactly what changes may result from certain modifications, especially with an uplift mind. While this means that there are still plenty of opportunities in the field of uplift research, it also means that those of us born uplifts are more prone to difficulties when undergoing psychosurgery or pursuing mental augmentations—or even performing routine measures like merging a fork.

That the genetic wiring of our brains has been so tampered with is a fact not lost on many uplifts. While few of us would go so far as to shirk the benefits of intelligence, it does lead one to ponder the motivations of one's designers. Why were we engineered with some cognitive characteristics but not with others? How much of our behavior is due to environment and upbringing, and how much is specifically engineered? Despite a moratorium on non-beneficial modifications in some enlightened jurisdictions, there is no doubt that many uplifts are raised that either lack certain neurological faculties or are designed to be enthusiastic about dangerous or demeaning types of work. Those who consider uplifts to still be animals or property have no qualms about making them into obedient slaves.

Non-Mammalian Brains

Uplifting non-mammals (which so far includes parrots, ravens, and octopi) is a much more difficult task than raising up primates, cetaceans, or even pigs. Part of the issue is size. Though sophisticated by the standards of their cousins, the brains of parrots, ravens and octopi are significantly smaller than the human cerebral cortex. This means that significant amounts of neural tissue need to be added to non-mammals. Of course, some neural material must be added for

mammals too, but in the case of large or human-sized uplifts it is usually sufficient to slightly thin and enhance the durability of the skull wall to make room for the extra material. In the case of ravens, parrots, and octopi, the creature's entire body was redesigned and enlarged to accommodate a larger brain.

Brain size is not a single factor, however. What matters more is the brain-to-body mass ratio and the encephalization quotient, meaning the size and weight of the brain in relation to body shape, size, and anatomy. The progression of brain sizes as animals get larger is not linear. This means that smaller uplifts such as ravens, parrots, and octopi (and also chimps and bonobos) can have smaller brains than humans but still have equivalent levels of intelligence. One of the big changes also made to uplift brains is the introduction of folds, ridges, and grooves into those previously smooth brains, providing more space for neurons in cramped quarters.

The biggest challenge for non-mammalian brains wasn't just size, but structure. Non-mammal brains are simply wired differently, with some parts of the brain taking on different tasks. Among avians, for example, the nidopallium is the source of higher cognitive tasks and executive functions. Restructuring non-mammalian brains to more efficiently emulate human cognition thus required a higher degree of re-engineering and experimentation.

Behavioral Adjustments

It is important to remember that successful uplift requires more than just gifting a creature with human intelligence, language, and locomotion. There are also behaviors hardwired into creatures by tens of thousands of years of evolution that need to be *removed* to facilitate acceptance into transhuman culture. Ravens are scavengers and thieves, stealing food from other birds and mammals—even from other ravens. Parrots are mimics, adept at picking up vocalizations and repeating them endlessly. In a social situation these tendencies (and others like them) can range in effect from severely irritating to criminal behavior. Similar traits need to be eliminated—or at the very least reduced so they don't exceed transhuman norms.

The most difficult behavioral adjustment to manage is that of sexual behavior. Adding human intelligence to an uplifted creature does nothing, by itself, to change behavior implanted in the deepest part of the creature's nervous system—and what is more important to any organism than the drive to reproduce? This creates potential problems as the sexual practices of certain baseline creatures is radically different than what is commonly accepted in transhuman culture. Wild bonobos, for example, are promiscuous, using sexual contact to build alliances, resolve conflicts, reduce stress, and even as a kind of greeting. There seem to be no permanent pair bonds in baseline bonobo culture and communal sexual behavior is common. On the other hand, there are documented cases of male chimpanzees and dolphins using rape to dominate both males and females in their social groups—a behavior clearly unwelcome in transhuman culture.

What makes this issue even more difficult is the unwillingness of most transhumans to try to control private sexual behavior. It seems unreasonable to sculpt uplifts so they fit some imagined "normal" set of sexual mores. In most cases uplift engineers attempt to modify brains to preclude sexual violence and leave most other baseline sexual behavior alone.

Overlying all of this is the problem that the decision of what is and is not desirable behavior was determined, often by committee, by a bunch of hypercorp scientists and suits. Much of the work by anarchist and exhuman geneticists has focused on alterations to the behavioral engineering norms that hypercorp scientists saw as "most desirable."

Along with brain alterations for behavioral adjustment, the most successful long-term uplift programs combined stringent efforts to socialize young uplifts according to human norms and culture. These programs operated much like the ones to shape AGIs into upstanding transhuman citizens, using similar protocols, though with a stronger emphasis on passing these lessons on to their offspring.

The Body

There's more to uplift than changing the brain. An uplifted organism is more than just a creature who can *think*. It's a creature whose baseline body evolved for an environment that no longer exists: Earth. As a practical matter, uplifts have to get along in a world that is almost entirely designed for the comfort and utility of Homo saps. This means massive overhauls to their bodies as well. Generally, that means achieving three key objectives: talking, manipulating objects, and moving around.

Speech

Human speech is a key requirement for uplifts if they are to fit within transhuman culture. All of the mammalian and avian uplifts could be taught to understand and respond to the human voice even in their baseline forms, but only the parrot could actually *talk*. What that means for the primates and pigs is the implantation of a human-style larynx and a modification to the neck bones and musculature to accommodate it. The raven's vocal structures were reworked to be more like those of the parrot.

The real challenge was giving the attribute of speech to the aquatic uplifts. Early attempts at fitting the uplifted dolphin's blowhole with a pseudo-larynx led to respiratory problems and interfered with the dolphin's ability to correctly interpret its own sonar picture. After a bottlenose with the adaptation crashed into the walls of his tank at better than 50 kilometers per hour, the pseudo-larynx was largely dropped. Thanks to advances in this field, most

cetaceans today can communicate vocally in air, albeit with a high-pitched voice and the occasional whistle or click. Octopi can similarly talk thanks to a transgenic vocal system, though their wispy-yet-raspy voices are known to creep some people out. It is not uncommon to find neo-cetaceans and neo-octopi that avoid speech altogether, instead communicating entirely via the mesh.

Some uplifts, particularly older germlines, are known to have difficulty with language in stressful situations.

Object Manipulation

The human hand is an extraordinary tool that grants Homo saps the unparalleled ability to manipulate their surroundings. Despite the omnipresence of mesh controls, no sapient being could hope to easily navigate transhuman habitats without the use of hands to push buttons, manipulate levers, or use touch screens. The great apes already possess hands that are very similar to humans, as do the neanderthals who require no modification at all (though *Homo Neanderthalensis's* pudgy mitts are often modified for aesthetic reasons.) Octopus arms are very different than human hands, but octopi have enough dexterity to easily manipulate their environment. Dolphins and other cetaceans fortunate enough to find an aquatic environment rarely *need* hands and rely on cybernetic arms or remote-controlled bots when they do, though a few heavily customized morphs include transgenic arms. Pig physiology took to transgenic human hands—and the skeletal and musculature changes behind them—quite well.

The birds, however, parrots and ravens, needed hands. This required some trickier engineering. Both species already had their wings restructured with bat genetics, enabling them to fold better. The new wing bone structure was also augmented to add dexterous finger digits to the peak of the wing. These primitive hands vary between morphs; some neo-avians have two or three digits and no thumbs, others have functional though weak-gripped hands.

Locomotion

Moving about is not much of a problem for the current crop of uplifts. Neanderthals and primates move around as easily as splicer morphs (or more easily in the case of chimps, bonobos, and orangutans, whose baseline incarnations spent enough time in trees to be comfortable moving around in the third dimension.) The neo-hominids were all gengineered to have an upward stance, with appropriate modifications to their skeletons and musculature. Neo-pigs were also redesigned to be bipedal, with their hooves replaced with standard human-like feet. Octopi can walk just fine on their eight arms (don't call them legs), especially in low gravity. Neo-avians aren't suited for walking long distances, but they get around fine and usually have the option to fly. The neo-cetaceans normally find themselves in aquatic environments; when they want to get around on land, they berth themselves in cetacean-adapted walker exoskeletons.

Mobility issues quite often aren't as big of a deal as they were on Earth. Given that our former terrestrial habitats were wiped out and a significant percentage of transhumans now live in low or zero-gravity environments, many uplifts have an even easier time getting around. The neo-hominids climb better than humans and can count on prehensile feet. Neo-avians fly even better in light gravity. Neo-octopi excel at pulling themselves along with their arms or using puffs of air to propel weightlessly across spaces. Just like humans, many uplifts pursue adaptations specific to their local environment.

Genefixing and Biomods

Like the various clades of genetically modified humans, uplift DNA is scrubbed of genetic flaws, congenital defects, and inherited diseases. Uplifts can be considered the equivalent of human splicers. It might even be said that uplift genetics are held to more exacting scrutiny and standards, given the gengineering effort focused on them. Most hypercorps and other groups developing uplifts have enforced strict breeding controls and banned reproduction unless individuals meet exacting genetic and aptitude test standards. Though decried by mercurials, some free uplift communities have adopted these eugenics practices themselves in an effort to produce the best specimens of their neo-species.

There is more to genefixing than just correcting genetic flaws, however. With the exception of parrots and pigs, which were at least partially domesticated when they were altered, uplift species were engineered from wild animals that lived in environments remote from humans. Even neanderthals were separated from humanity, not by space, but by time—200,000 years. When an organism is exposed to another organism from a different environment, there is the possibility of passing along infectious diseases to which one of the organisms has never developed resistances or immunity. A well-known example of this phenomenon is the disastrous interaction between human beings and the baseline mountain gorilla. Common influenza is fatal to the gorilla and in pre-Fall days, inadvertent exposure to flu via humans dramatically depressed their numbers. A major part of the genefixing process for uplifts is to confer immunity against the thousands of viruses, bacteria, molds, and spores common in transhuman environments. Even today, uplifts are often the most vulnerable to any new diseases or strains that evolve or are discovered.

Another danger is the creation of novel transgenic diseases moving the other direction—from uplifts to other transhumans. This is not an idle consideration. Two H1N1 flu pandemics swept the world in 1918 and again in 2009. The 1918 pandemic was a monster, killing between three and six percent of the world's total human population. H1N1 is a traveler,

UPLIFT GENETIC SERVICE PACKS

If there's one thing hypercorps are good at, it's keeping their customers hooked. The scheme of supplying indentures on Mars and elsewhere with biomorphs suffering from built-in obsolescence, requiring periodic genetic service pack maintenance to stay healthy, was actually pioneered for use with uplifts. By inflicting uplift bodies with genetic conditions that required regular specialized healthcare, the uplift hypercorps found a way to bind their progeny even closer and discourage any ideas about eloping. Though not all uplift hypercorps continue to use these methods (Somatek notably discontinued this after Duvalier moved on), many use genetic service packs to keep uplifts under control and within reach. ■

jumping between swine and birds and humans. This was a major concern expressed by anti-uplift groups early on, that modifying animals to be more similar to humans and integrating them into human populations would create an opportunity for quick mutation and transmission of disease. In order to combat the possibility of pandemic, early uplifted avians and pigs were designed to respond to influenza with purple spots so the disease could be easily diagnosed and treated. Now that basic biomods common among both uplifts and other transhuman morphs avoid the cytokine storm triggered by H1N1 and other viruses (an overreaction of the immune system that is thought to explain the flu's high mortality rate among young and otherwise healthy people), this is less of a concern.

Like most humans, uplifts now have the genetic modifications that provide longevity, allow their bodies to regenerate, and protect them against most known diseases. Uplifts are also bestowed with upgraded livers and kidneys to better filter toxins out of their environment. With small body masses, birds are particularly vulnerable to environmental factors. The same can be said of aquatic creatures like cetaceans and octopi, who live in an environment through which toxins can quickly diffuse.

LANGUAGE

Many uplift candidate species already possessed some linguistic capabilities or even rudimentary language, "speech patterns," and syntax rules, beyond that of simple animal communication. The whistles and clicks of the cetaceans and the baseline parrot's ability to imitate human speech are two of the most obvious examples. Language is not just a cultural phenomenon—there is a strong genetic element as well. Uplift minds have been specifically modified for linguistic functions and, in particular, human language. This was reinforced with carefully designed language courses over each uplift species' development. There is some controversy among mercurials who believe that uplift researchers did not do enough to promote and develop native languages for particular uplift species. The only uplift language to exist is cetacean, which is notably primitive and limited, despite efforts by neo-dolphins and whales to extend its capabilities.

Despite the ridiculous characterizations of those prejudiced against uplifts, uplifts speak the same common languages as other transhumans. Mandarin, Russian, and English are especially common among uplifts, but many others speak Portuguese, Japanese, Hindi or other tongues. Gengineering and socialization also steer most uplifts towards using the same non-vocal communication kinesics as transhumans, from gestures to microexpressions. Nevertheless, humans sometimes find it a bit more difficult to read an uplift's nonverbal cues, especially with less humanoid uplifts such as neo-octopi and neo-avians.

It's interesting to note that uplifts often unconsciously incorporate elements of their baseline linguistic tendencies into their everyday speech. If reinforced by the presence of others of their kind, this behavior essentially leads to a species-specific uplift dialect of modern human languages.

SOCIALIZATION

As early AI scientists suggested, the best way to socialize an alien intelligence is to raise it exactly as you would a human child. The same methodology was used for uplifts. In the early stages of uplift (and today still in many research centers), the raising of uplift children was handled in clinically controlled environments. The standard model was to rise them in mixed-sex crèches of a dozen individuals, cared for by an uplifted individual of the same species and/or human minders. It was not uncommon for uplift children to not be raised by their biological parents, if they could be said to even have parents—most were engineered from the genetics of three or more of their predecessors. Most of these children lived lives that any human would recognize. They were educated in similar school systems, exposed to the same media human children were, played the same childhood games, and were taught the same lessons about norms, customs, responsibilities, and social roles. As various uplift projects advanced, some of these were integrated with human children, so that they lived and went to school side by side. The difference for uplift children, however, was that they were subject to a never-ending barrage of aptitude, learning, and intelligence tests, and sometimes served as test subjects for drug regimens, implants, nanosurgical enhancements, or even psychosurgical alterations.

The primary goal of socialization is to infuse uplifts with the same cultural values, ideologies,

and ethical standards as the rest of humanity. It would be foolish to think that no hypercorps have experimented with other forms of socialization—or no socialization whatsoever—but these projects and their results are neither publicized nor publicly acknowledged. It is also important to remember that many hypercorps instilled particular noxious notions among their uplift subjects. Many uplifts were raised as second-class citizens, either inferior, less capable, or less important to humans. Many also were repeatedly instructed that they owed a debt to their patrons for having been uplifted, a debt they could only repay by a lifetime of service—in the best interests of their children and their species. Others were instilled with what can only be called slave ideology, raised to be obedient and demure workers, reinforced with repugnant mental alterations.

REPRODUCTION

It's time for a little talk about the birds and the bees. As with all things uplift, the subject of sex is a little more complicated than it might first appear.

During the early days of uplift, these creatures were property. More than that, they were *experiments*. And when an experiment goes bad, you don't want it running around, creating other little experiments.

From the very earliest days of uplift, the reproduction of subject creatures was tightly controlled. Only germlines that were deemed significantly positive were allowed to reproduce. And by reproduce, I mean the subject's genetics were deemed acceptable to keep in the library that particular lab kept on hand to modify further, splice with other genetics, and eventually use to grow a new fetus in vitro. Uplift subjects were almost universally sterilized or otherwise prohibited from sexual procreation. They could have sex, they just couldn't breed. This philosophy has mostly been carried on to the present day, particularly with uplift research programs, but even sometimes with independent uplift communities. Each uplift's particular germline is analyzed and measured, with information complemented by various test results. Sometimes even the most carefully gengineered uplift DNA will have errors that take years or even decades to recognize and fix.

Reproductive control is also a grand way to keep money in the pockets of the hypercorps. Like many transhuman morphs, an uplift's particular genetics are considered intellectual property. Built-in genetic controls prevent sexual reproduction and sometimes even hamper cloning. The genetic code is almost always signed in the actual DNA itself, making it easy to identify who it belongs to.

If you've been paying attention so far, you realize that most uplifts have no control over their reproductive prospects.

It's a beautiful story, really. Dolphin meets dolphin. Dolphin and dolphin fall in love. Dolphin and dolphin try to scrape up enough money to pay Somatek or

JAKE

Source: Somatek Research Material, Project Orangutan, Interview with Olivia Orangutan [Link]

It was already one of the bad days. My throat still hurt from the surgery and the attendants had given me a 'jection to change the shape of my throat bones, the hy-oid. Least that's what Dr. Vitter called it. They kept telling me to talk talk talk, but it just hurt. I don't know why they wanted me to talk so much anyway, I just sounded scratchy, not pretty like the way Dr. Vitter talks.

All I wanted was for it to stop hurting and to go home and sleep in mamma's arms. Sleep sleep sleep. Not talk talk talk.

The worst part of it was Jake wasn't there. Jake's my brother. He's orang like me. He has red hair that sticks straight up and big black eyes bulging out of his face and he's always making funny 'pressions with his mouth. He's not beautiful like me. I'm beautiful because I'm a girl, but Jake can't be beautiful. He's a boy. Boys are handsome.

Anyway, he wasn't there.

I asked Dr. Vitter where Jake was and his face kind of froze up like when he was mad, though I didn't do anything wrong to make him mad, I just asked where was Jake.

He got down on one knee so his face was real close to mine and he said, "I'm sorry, Olivia, but Jake didn't make it through the surgery."

So I asked, "Why doesn't Jake have to do the surgery if I have to?" It was a little mean, because I shouldn't have been trying to get Jake into trouble just because he lucked out, but I was feeling cranky and my throat really, really hurt.

Dr. Vitter just looked at me real sad and he said, "I'm sorry, Olivia." He stopped like he was choking on something and I felt a little bad for him. Talking is hard. I know.

And then he said, so softly I almost couldn't hear him, "Jake died."

I just looked at him.

"Jake is dead," he said.

"That's not right," I said.

"Olivia," he said real soft.

"That's not right," I screamed and then I hit him even though I know that's really, really bad and I ran away screeching in my orang voice even though I'm only supposed to talk English now.

I ran to Mamma and I said, "Jake is dead, Mamma. Dr. Vitter said Jake is dead. It's not true, Mamma." And then there were these weird feelings in my throat and my chest, like when you're choking on a piece of fruit, except it happened over and over again. I couldn't make it stop. "Tell me Jake's not dead. Tell me."

But she just looked at me and she didn't say anything. It was the first time I really understood what Dr. Vitter had been telling me. Mamma couldn't talk. Not like me.

Mamma and I lost our Jake and she never said anything about it.

whatever hypercorp owns their genetics to make them a baby. Shakespeare, it's not.

The price charged by the hypercorps for genetic rights is not staggering, but it's far beyond the average Jesse Uplift—especially if they're also paying off the hypercorp debt for their *own* uplift, as some patrons require. Most hypercorps will not even consider selling uplift genetics unless a license has been acquired first—meaning that the genetic profiles of the partners (however many there are) must be approved first, both for compatibility and as beneficial to the improvement of that particular uplift species. This requires a significant bit of testing and analysis—also prohibitively expensive. The Consortium and similar authorities back these measures with law.

Even if you get genetic rights and a license, well, that's just the start. Someone actually has to blend that genetic material together to make a zygote and then grow it in an exowomb (or if you're particularly old-fashioned, implant it in a surrogate parent, but who outside of the Junta wants to go through that bother anymore?). That includes state-of-the-art genetic engineering and the cost of maintaining a team of technicians and doctors working for the gestation period. That's another significant cost.

If the uplifts actually want to experience the fun part of reproduction, that's possible too. Believe old Blue, uplifts are quite capable of engaging in sex and *enjoying* it, but they come from the factory shooting blanks. Fortunately, fixing that problem is an easy hack. It does require buying a licensed genetic service pack that will turn the reproductive cycle back on. That's right, more money.

If you're part of an ongoing uplift research project, that many not be the end of it. Your patron hypercorp may demand as part of the licensing that your child be raised in a particular habitat under the conditions of a particular program, so that their growth can be monitored and evaluated. That means your child may be a test subject. Some hypercorps go so far as to raise the child themselves, outside of parental supervision, for the first year—and sometimes longer. And they charge you for that too.

For many uplifts in the solar system, this not a system they can afford. So there is a great desire in the uplift community to have children and no practical way to make that aspiration a reality. Needless to say, when there is an unmet need the black market will step in to find a way. Various cartels offer services to unlock genetic protections or raise pirated children. While cheaper, these are still expensive options. Uplifts pursuing these routes are advised to tread carefully, as cartels often seek to enhance their profits by cloning the genetics, blackmailing the prospective parents, and similar unsavory methods. There are plenty of coyotes out there preying on transhuman weakness; people like renegade exhuman scientists who'll promise anything to anyone if they think they can separate you from your coin.

It gets worse. The uplift hypercorps regard uplift genetics as their trade secrets and work hard to protect their IPs, both in the courtroom and the laboratory. One of the tricks they use to deter piracy is to deliberately introduce DNA coding errors that manifest in newborns as random birth defects. If the reproduction is handled properly, through that hypercorp, these errors are methodically removed. It's easy to do—if you have a road map. These errant base pairs can also be repaired on the fly—if you can find (and afford) a trustworthy technician who is an expert in the uplift of your particular species. Or you could go forward without the expert and hope the defects you get are something that can be fixed.

Not all of the hypercorps are so restrictive, of course. Some take an enlightened view towards uplift reproduction, though they are rare and usually found in the Morningstar Constellation or in Extropian habitats. Thousands of uplifts, of course, exist outside of hypercorp control, particularly in autonomist strongholds or mercurial habitats. These uplifts are free to pursue reproduction as they see fit, on their own terms. Various autonomist, argonaut, and mercurial projects produce uplift germlines with genetics that are public domain and unrestricted. Some of these groups even make efforts to reverse-engineer the DNA of hypercorp-produced uplifts.

Mistakes, Failures, and Rejects

The beginning of uplift was a bloody, terrible business. Humanity just didn't know enough about baseline animal brains to get it right on the first try, or even on the hundredth. It took decades of concentrated study to achieve even passable results and decades more before the techniques were more or less perfected. When dealing with something as complex as brains, there is no such thing as 100% success. Evolution took millions of years to mold the animals of today, ruthlessly culling genetic errors and susceptibility to disease and maladaptation to environment. Killing countless millions of individuals in generation after generation so that those who remained would work better, be more flexible, fit their environment more perfectly. As humanity tried to escalate thousands of years of changes into a few decades, not to mention the transgenic mods, there were bound to be failures and mistakes. The progress of moving from zygote to being is complex and in some ways, still deeply mysterious. It's not just decoding the DNA molecule, but the interaction of genetic material from parents and other sources, the proper activation of genes, the presence of the correct proteins in the correct ratios at the correct times, the impact of environmental factors, etc. Needless to say, uplift is in many ways more of an art than a science. No matter how smart we transhumans *think* we are, we've no doubt introduced thousands of bugs into the software of our uplifts and it will be centuries before we begin to understand them and work them out.

DEFECT ESCAPES

From: [REDACTED], Quality Control Manager
To: [REDACTED], External Security Director
Subject: Quality Control

Really don't appreciate this attitude, [REDACTED]. I don't care what the damn commercials show. Whether Marketing likes it or not, uplift production is a manufacturing process and every manufacturing process has QC issues and, ultimately, escapes. My department has kept quality escape levels well below 100 ppm, which is entirely acceptable for a world-class process of this scope and complexity.

Following is the list you requested of all known escapes. If your department needs assistance in bringing these quality issues to a quick and quiet resolution you will have my full support. But, [REDACTED], let me assure you, if you're just planning to score political points off me, you'd better score a lot. Because if you make me your enemy and you leave me standing, there's going to be hell to pay.

Signed, [REDACTED]

- Subjects 123, 126, 127, 142. Chimpanzee. Males. All genetic descendants of Subject 119 (Jumbles). Eloped 6 AF, likely with help. See file on Santos, K. All four subjects suffer from numerous non-debilitating defects including stuttering, suppressed immune system, depression. Not dangerous. Termination not required. Current location unknown.
- Hector473. Dolphin, Atlantic bottlenose. Male. Eloped 8 AF. Suffered from psychotic episodes and paranoid delusions. Extremely violent. Killed minder and egocast to Mars. Likely has jumped morphs several times. Dangerous. Current location unknown.
- Black32. Bonobo. Female. Eloped 9 AF. Subject is aphasic, totally unable to speak or comprehend spoken language. Subject can understand written language. Psych analysis suggests subject is a brilliant sociopath. Likely using custom-developed muse to overcome handicap. Apprehend at all costs. Extremely dangerous. Current location unknown. ♣

So, what can go wrong, you ask? Well, remember, you *did* ask.

Minor errors in a single gene can cause internal organ failures or compromise the immune system. Health problems were not uncommon in many early strains. When making many radical changes all at once, it's possible to have physical deformities. These were far more common in the early decades. I've seen bootlegged records of an octopus with a tentacle growing out of its head, of a wingless raven, of a gorilla born without a mouth, just smooth skin where the lower half of her face should have been. If you have the right connections, it's possible to drown in such images.

As bad as the physical errors are, the ones you can't see are worse. A damaged brain is much harder to diagnose and, since most of the action in the world of uplift involves redefining the cerebrum, they are also much more likely. There have been reported cases of uplifts suffering from schizophrenia, amnesia, violent psychosis, hallucinations, paranoid delusions, autism, depression, catatonia, and, perhaps most cruelly, aphasia—the inability to use or understand language.

These mistakes and rejects were learning opportunities for the hypercorps. Rarely was an attempt made to heal or repair the subject. It was a far more common procedure to euthanize the unfortunate victims and perform an autopsy so that the scientists could learn from their mistakes. Some were spared, however, left to live with crippling deformities or other defects.

Today, these mistakes are less of an issue. The current state of genetic therapies and nanotech allows us to rewrite an uplift's genetic code, counteracting the most grievous mistakes and abnormalities. You will rarely see independent uplifts with such noticeable problems or defects. In certain hypercorp research labs, however, genetic repair is considered an unnecessary expense and so entire communities of malformed or impaired uplifts exist, carrying out their indentured tasks with no hopes of seeing a better future.

UPLIFT SPECIES

Before we get down to the nitty gritty of how we've managed to integrate into wider transhuman society, it'd probably be helpful to take a closer look at the different uplift species and their peculiarities.

NEO-HOMINIDS

And the book of all truths sayeth: "First Man uplifted the chimpanzee." Book of Jumbles, Chapter One, Verse One. When the mad scientists took it into their heads to make something better out of God's humble creation, they started where they always start: with the chimpanzee.

It's a common misconception that chimp DNA differs from *Homo sapiens sapiens* genes by only a single percent, but this number is apocryphal. In actuality, the degree of similarity of human and chimp genetic code depends mostly on how you count. Since all complex organisms from Earth possess great swaths of junk DNA inherited from a distant common ancestor, there tends to be startling similarity between *many* organisms. Sure, humans are like chimps—but they're also like flatworms and fruit flies. (Which may explain some of the encounters I've had with biocons.) Also, it's important to remember that DNA isn't the sole determinant of genetic expression. Epigenesis (the changes in an organism caused by mechanisms other than DNA) plays a significant role in determining phenotype. And let's be honest, apes that grow up on a diet of bananas and termites are going to develop differently than apes that grow up on a steady diet of Red Dye Number Five.

Despite all that, there's little doubt that the chimpanzee is humanity's closest relative. For one thing, you look *identical*. Ugly. And hairy. I can hardly bear to look close enough to tell you apart. And you share many of the same behavioral traits. (Though on the whole I've found chimps to be better mannered.) Given the genetic similarities, the intelligence and tool use, the complex social structures, and strong social bonds, it's no surprise the various hominids were the first species to be uplifted.

All of the neo-hominids walk upright, though some have been known to knuckle-walk or switch to all fours when injured or in times of stress. All are great climbers, and their prehensile feet help both with climbing and maneuvering in microgravity environments. They retain the body hair of their non-uplifted forebears, though it is a common cultural practice to dye, stylize, and otherwise manipulate their hair in certain communities. Transgenic vocal systems allow them to speak as humans do.

Of all uplifts, neo-hominids have assimilated most easily and thoroughly into transhuman culture. Most of them have no issue wearing the same clothes and using the same gear that humans do, without modification. Humans tend to acclimate to them more easily, and both tend to adjust relatively easily to each other's morphs. Given the closeness, neo-hominids are also more thoroughly socialized. They laugh as easily (even if it sounds more like hoots), they emote similarly, they're sexually compatible, and they tend to think in similar ways as humans do. It is perhaps all the more grating when neo-hominids have to put up with being called "monkeys" or "Dr. Zeus," not to mention the institutionalized discrimination all uplifts face. Working in their favor is that many prejudiced humans seem to find neo-hominids more physically threatening than other uplifts, giving them some extra leeway when playing up their big mean ape persona.

Neo-Bonobos

Cousins to chimps, neo-bonobos are more slender and have longer legs. They also tend to have longer hair and a less prominent brow ridge. Though socialized as transhumans, matriarchal instincts still linger in neo-bonobos and females tend to have more influence, both individually and collectively, in their communities. The hypersexuality exhibited in pre-uplift bonobos is also still present among uplifts, and sexual contact for greeting, conflict resolution, and reconciliation remains common between neo-bonobos (and sometimes with others). The vast majority of neo-bonobos are bisexual.

Neo-Chimpanzees

Uplifted from the common chimpanzee, neo-chimps are perhaps the most common uplift and the most well-integrated into transhuman society. Neo-chimps generally stand just shorter than the average human. Their legs have been elongated, closer to human dimensions, but still not as long as their lengthy arms. A natural photographic memory was a common trait identified in early uplift subjects and is a standard feature of many neo-chimp germlines.

Neo-Gorillas

Male neo-gorillas are of average human height, though usually significantly sturdier and stronger. Females tend to be shorter (~1.5 meters). Males who achieve positions of authority and influence express silverback characteristics, growing larger canines and a silver patch of hair on their head and back.

NEO-ORANGUTANS

The smallest of the great apes, male neo-orangutans stand just shorter than neo-chimps, and females even shorter. They have longer arms, however, with a standard arm span of 2 meters. They retain the throat pouch physiology of their non-uplifted ancestors, allowing them to be quite loud when they want to be. Several neo-orangutans have made impressive artistic careers as singers.

NEO-CETACEANS

Uplifting whales and dolphins presented a whole different set of problems, even though we cetaceans are smarter than chimps, going by encephalization quotient. (Don't believe me? That's because you're a victim of your monkeycentric point of view.) We may be smarter, but we are also very *different*. When humans thought to muck around with our brains, in a very real sense they were dealing with an alien intelligence.

"But, Blue," you're saying. "You guys aren't aliens. You're from Earth. You're even *mammals*."

Sure, mammals. Right. We're exactly the same. Think through this for a minute. What is the principal biological characteristic of human beings? *Standing upright*. You *walk*. You guys are the very definition of two-dimensional. But not us. Dolphins leap, dive, cavort, race, and surf. Our brains are *designed* to operate in three dimensions. (Which is why we are so wonderfully adapted to space, by the way.)

There's more. Our use of echolocation is more than just another sensory input. We employ sonar to construct a detailed, three-dimensional model of space around us. The torrent of sensory detail that sonar provides has shaped our brains just as thoroughly as your visual acuity has shaped yours.

Finally, dolphin social order is radically different from human cultural hierarchies. A fair part of the difference arises from dolphins' inability to keep secrets. If a dolphin is pregnant, if they're ill, if they're sexually aroused, if they're digesting a *fish*, every dolphin in her pod knows it. There's no hiding from sonar. As a consequence, dolphin culture is extremely open. Subgroups drift in and out of pods, pods engage in the communal rearing of calves, and we are less hung up on sex than you people are. Few things drive changes in neural architecture more rapidly than mating strategies.

Despite these differences, cetaceans were the second group of species to be uplifted after hominids. The difference between our brains means it took longer to uplift us and there were many more mistakes, even though we had the shortest way to go.

There are, of course, significant physiological hurdles to integrating cetaceans into transhuman culture. For one, we are aquatic creatures. On Earth, this was less of an issue, given the bountiful oceans and growing number of undersea settlements. Post-Fall, this is a significant problem. There are but a handful of aquatic habitats in the solar system for neo-cetaceans to thrive in their natural environment, and a few more extrasolar options. There is also the option of becoming a Solarian and swimming the solar corona. But if a neo-cetacean wants to visit anywhere else in a dolphin morph, they need to slide into an exoskeleton walker or micrograv sled to get around. Thankfully, some genetic tweaks to our skin keep us from drying out so quickly when not immersed in water. Second, there is size. Orcas and whales are *large*—too large to comfortably maneuver in standard transhuman living or work environments. Third, there is the lack of hands for tool manipulation. This handicap is easy to bypass with cybernetic implants, harnesses, exoskeletons, or simply by using robots and mesh commands.

It is rare that you will find a neo-cetacean in a native morph outside of an aquatic habitat. In truth, there is more to this than just morphological challenges. Among humans—and shamefully among uplifts as well—there is an undercurrent of prejudice. Those who are more human are favored over those who are less. Humans find us cetaceans to be odd at best, alien at worst. According to the stereotypes, dolphins are flaky tricksters, orcas are creepy psychos, and whales are puzzling mystics. Even other uplifts look down on us, considering our aquatic specialization to be a handicap.

NEO-DOLPHINS

Numerous dolphin species were uplifted: common, bottlenose, striped, spinner, to name the most common. Most neo-dolphins are genetic mutts, with traits from several species. Most are gray, blue, or black in color, sometimes with white underbellies, and average 3 meters in length. The most numerous neo-cetaceans, these survive primarily in Atlantica or Europa. They are the neo-cetaceans most gregarious with humans; many neo-dolphins have resleeved in human morphs and assimilated into mainstream transhuman society, though they often do so in traditional pod social units.

NEO-ORCAS

Neo-orcas get a bad rep for their predatorial roots. Technically, all cetaceans are predators; orcas just happened to be the only ones that regularly fed on big mammals. Their hunting may be responsible for their intelligence, though. The scientists who engineered them were allegedly careful to weed out any antisocial killer instincts, but there's no denying that neo-orcas are the bad boys and girls of our little uplift family.

What most people don't know is that orcas had complex matrilineal social structures even as animals, and these were maintained through the uplift process. Neo-orcas tend to stick together, particularly with family. Most adhere in social groups centered around the mother who raised them, even if they only actually share a few genetic traits with her. This is true in all

SOLARCHIVE SEARCH: DEEP CURRENT BLACK KILLER OF SQUID

The most well known neo-whale is likely Deep Current Black Killer of Squid. Escaping Earth as an infomorph during the Fall, Deep Current had been renowned among his people as a hunter of Architeuthis—the giant squid. It turned out that what made him a brilliant hunter of squid—patience, instinct, and real-time quasi-mathematical modeling of a score of environmental variables—also made him a brilliant hunter of lost satellites, spacecraft, iceteroids, comets, and even corpsicles. Deep Current was the finder of all lost things, and that particular skill made him rich. After building his wealth as a post-Fall scavenger, Deep Current Black invested a substantial fortune into the establishment of the water habitat of Atlantica. While certainly the richest neo-whale in the solar system, he may be the wealthiest and most influential uplift in transhuman society. He consistently denies rumors that part of his fortune was earned by retrieving artifacts from Earth after the Fall or that he retains ties with criminal cartels. ✤

aspects of culture, from living arrangements to businesses, though as neo-orcas become more and more exposed to other transhuman social relations, larger numbers of them are breaking free from their instinctual and socialized ways and living differently.

NEO-PORPOISES

Porpoises are very similar to dolphins, just usually smaller, faster, and less acrobatic, with shorter snouts. They average 2.5 meters in length. Gengineered primarily from harbor porpoise genetic stock, they are less numerous than neo-dolphins and -orcas. They are primarily found on Atlantica.

NEO-WHALES

During the late 20th century, it looked like humanity would finally wipe out our larger cetacean cousins by excessive whaling and habitat destruction. It turned out that a partial ban on whaling and stricter protection of marine habitats rescued the whales … barely. When the first humpback was uplifted, followed soon after by beluga, sperm, and blue whales, no longer did anyone have to speak for the whales—they could speak for themselves. It was to be a short-lived victory.

There was no doubt that the Fall was a tragedy for all the peoples of Earth—but the whales suffered worse than most. Most whales weigh north of 10,000 kilograms—and that doesn't even take into account the weight of the water needed to immerse their massive bodies. The spacecraft hasn't been built that could punch that kind of payload into Earth orbit. Even if such a creature could have escaped the clutches of the TITANs, where exactly would it go?

The neo-whales were wiped out far more thoroughly than humanity. Five calves did manage to escape (three humpbacks, a blue, and a sperm), carried up one of the space elevators while their parents waited behind to die. Another thirty-four uplifted whales escaped the Fall as infomorphs. In all, thirty-nine neo-whales survived the loss of Earth. Along with the 186 whale uplifts born and raised in the seas of Ceres and Europa, neo-whales were a critically endangered species.

The research of various whale uplift programs survived, however, along with several thousand samples of the whale genome. Luckily whales are a patient, mindful lot. They are confident that they will rebuild their numbers. Perhaps more than many other uplifts, neo-whales have adopted the transhuman mindset. Few retain their original neo-whale form, instead sleeving into Europan-adapted neo-whale morphs, with dozens more becoming suryas or sleeving into humanoid morphs. Some day, the mightiest creatures to ever ply the Earth's oceans may become the first species to become completely postbiological.

Unlike other neo-cetaceans, you'll never see a neo-whale morph (carrying a neo-whale ego at least) with cybernetic arms or couched in an exoskeleton. Fine manipulation of objects on the human scale is simply … beneath them. If they require the use of tools, they almost always employ robotic aid.

NEO-AVIANS

Though bird brains have some notable structural differences, the brain-to-body-size ratio of parrots, crows, and ravens is equivalent to the higher primates and they exhibit distinct similarities to human minds, particularly with the cerebral cortex and brain waves. Aside from increasing brain size and other cognitive upgrades, the primary issue for uplifting neo-avians was how to change their physiology, particularly the wings. In order to provide neo-avians with manipulative digits and hands, it was necessary to splice in bat genetics to change their wings' skeletal structures. This had the added benefit of allowing them to fold their wings better.

Along with their increased cranial size, neo-avians are much larger than their animal cousins, though still small compared to humans, roughly equivalent to a five-year old child. These physiological changes were not as simple as they seem. In order to sustain terrestrial flight, neo-avians have to be light. To compensate for this increased mass, their bones are engineered to

be both stronger and lighter. Still, neo-avians are not as nimble fliers as their animal progenitors.

The same doesn't hold for avians living in microgravity environments, of course. Like cetaceans, birds live their lives in three dimensions. Neo-avians thus excel in micrograv environments; another reason the hypercorps focused on them as early research subjects. This did require some esophagus modifications, however, since non-uplift birds require gravity to swallow and so would die of thirst in micrograv.

Compared to humans, baseline avians have superior visual acuity. Not only can they see farther and more sharply, they can resolve rapid and slower movement better, meaning they can see things that humans would detect only as a blur or as imperceptible movement. Neo-avian eyes can also see more colors than humans and are also sensitive to the ultraviolet spectrum. Their eyes are also protected by nictitating membranes.

Baseline parrots start out with clawed zygodactyl feet (four toes arranged in two pairs, front and back), while ravens and crows have three toes facing forward and one back. Both are dexterous and well-adapted for grasping. In some germlines a thumb-claw is added, effectively making the feet prehensile, and the foot is considerably strengthened.

NEO-PARROTS

The complex vocal apparatus of parrots allows them to use language, that most unique of human gifts. Even apes cannot speak as humans—not without some serious hardware changes, that is. Parrots talk the talk.

For uplift purposes, this is a bigger deal than it might at first seem. It meant their brains were already carefully attuned to vocalizations. It gave them the opportunity for language to reinforce intelligence, an echo of the feedback loop that helped give rise to human intelligence. Where even today, some neo-hominids have trouble with language under stress, neo-parrots remain the most gifted talkers when it comes to uplifts. Stereotypes are often backed by fact, and there's a reason so many neo-parrots do well as marketers, entertainers, and bartenders—and why you don't want to get trapped in a corner by one at a party.

NEO-RAVENS

The common raven, *Corvus corax,* has the largest brain of any bird species, a fact demonstrated by its advanced behavior. Scientists have long observed sophisticated problem solving by ravens. The bird will call wolves and coyotes to a kill to get the canines to tear open the carcass for it. It's also a trickster, building fake food caches in front of other ravens to protect itself from theft. And the raven is playful, another sign of intelligence. Ravens have been observed sliding down snow banks and making toys (twigs) for social play.

Neo-ravens have exceeded these expectations. As a species, they consistently score higher on sapience tests than many other uplifts. They have a reputation for being clever, witty, and scheming for a reason. It may also have something to do with their infamous unblinking stare. Just don't rib them too hard about considering corpses a delicacy—some of them get a bit touchy about their carrion-feeding roots.

NEO-CROWS

Many people get neo-ravens and neo-crows confused. In truth, they are similar, both physiologically and culturally, and often intermix. Though baseline crows are smaller than ravens, neo-crow uplifts are nearly similar in stature to neo-ravens. The primary physiological differences are beak size and wing tips. Every neo-crow and neo-raven I've known acts offended if you mix them up, but I suspect they do this just to take the high ground.

NEO-OCTOPI

Octopi are the only invertebrate uplifts and in many ways are the most fascinating case. At first glance a mollusk would seem like an unlikely candidate for uplift. (Why uplift an octopus and not, say, a dog?) But it turns out baseline octopi are cunning hunters, brilliant problem solvers, and—sometimes—merry tricksters.

One pre-Fall marine biologist had an octopus in a tank and a crab, a favorite octopus prey species, in *another* tank all the way across the room. He left for the night, came back in the morning and found a very fat octopus—and no crab. Turned out the octopus had climbed out of its tank, walked across the room, climbed into the crab's tank, *ate* the crab, and returned to its own tank. Cunning, brilliant, and playful.

So why are octopi so smart? First off, they are predators, well-versed in the complexities of the hunt. They are able to twist their flexible bodies into fantastic shapes or jet off at high speeds, obscuring their retreat with a cloud of ink. The octopus brain is adept at deciding which strategy is appropriate for the tactical situation. Their vision is nearly as sophisticated as that of Homo sap. And a great deal of neural processing is required to operate eight independent prehensile limbs. It requires even *more* to control a complex network of chromatophores to produce astounding camouflage patterns for a variety of different environments. All these factors made altering the octopus mind the most difficult of the uplift projects—and perhaps the most rewarding.

There are many species of octopi, but scientists chose the Pacific giant octopus to uplift due to its great size. The Pacific normally reaches a size of fifteen kilograms and an arm span of more than four meters, though specimens have been found that are more than five times larger than this.

Fans of the octopus say the creature's all heart. While that may be a slight exaggeration, the octopus does have more than its fair share of hearts—it carries *three*. The two extra hearts are often called gill hearts, as they force blood though the gills to be oxygenated. The main heart sends blood through the rest of the octopus's circulatory system. When you add in a transgenic lung system, everything changes. The first and most important change is in the blood. Baseline octopi are true blue-bloods. And no, I don't mean they play polo and look down their beaks at new money. The octopus transfers oxygen around his body by using the copper-based molecule hemocyanin, which gives its blood a characteristic blue color. Unfortunately, hemocyanin is not nearly as good at oxygen-fixing as its iron-based cousin hemoglobin, meaning your average baseline cephalopod isn't very energetic. In uplifts, hemoglobin is substituted for hemocyanin. In theory, this means an uplifted octopus has more energy than its baseline cousin. But it also means the creature has to extract *more* oxygen from its environment. This means more rapid respiration and a host of muscular changes to support it.

All of this is very weird, but not nearly as weird as what comes next. There's another problem with air other than the inconvenience of having to *breathe* it. It does next to nothing to provide structural support. Many creatures that look beautiful and graceful in the supportive waters of the sea look like a stray scrap of intestine lying on the deck of a ship. Octopi evolved in an environment that provided their delicate bodies with inherent support. Transhuman habitats aren't quite so kind. In order to move around in a gravitational field, most uplifted octopi have been modified to include a flexible sheathe of cartilage that protects the delicate organs in the creature's mantle (the sack behind its eyes.) A careful system of powerful muscles joined to this sheathe allows the octopus to hold itself upright. The support requirement ends at the base of the arms—they are powerful enough that there is no need to supplement them.

Octopi also underwent a number of sensory changes during uplift. Baseline octopi have limited auditory senses via their balance-providing statocyst organs, which act like primitive cochlea that can only perceive low frequencies. For neo-octopi, this sensory organ was upgraded with transgenic modifications, enabling uplifts to hear similar frequencies as humans. In some germlines this audiosensory capability is limited, underdeveloped, or absent, but this is easily compensated with audio implants or external mesh-linked devices. Baseline octopi also lack a sense of proprioception for their arms—the only way they can tell what their limbs are doing is by looking at them. This was compensated for by adding neurofeedback connections between the arms and brain, but this sense is more well developed in some germlines than others.

On the other hand, baseline octopi have several sensory advantages that were kept. Their unique eye structure, which evolved separately from that of primates, is sensitive to polarized light, meaning they have better visual acuity for seeing things like stress fractures in transparent materials, transparent objects in water, and other patterns that human eyes—even with enhanced vision—cannot see. Thanks to an autonomic response, the pupil slits of octopus eyes are always oriented to be horizontal, which enables neo-octopi in microgravity situations to keep their orientation very easily. Octopi also have an excellent

UPLIFTS, MEDICINE, AND DRUGS

No matter how much uplifts have been crafted in the image of humans, our physiology remains quite different. Doctors and machines skilled in human anatomy may face challenges when diagnosing or performing first aid or surgery on an uplift. Organs are in different places, may not exist, or may function differently, not to mention more complex biological systems. While healing vats may be easily programmed for specific uplifts and morphs, it is possible that remote facilities or medical practitioners may not be adequately prepared for treating sick or injured uplifts.

Similarly, many drugs that affect (trans)human biology will have different effects or no effect on uplift bodies and minds. This is especially true of the non-mammals. Hormonal levels may be different, neurotransmitters may be located in different places, neurological systems may be structured differently, proteins may bind differently, etc. As a consequence, some uplift-specific versions of recreational and smart drugs have been developed, with unique effects upon specific species. Some of these affect uplifts in ways that humans will never experience, such as the drug hydra, which enhances the autonomy and unconscious reflexiveness of neo-octopi arms, while limiting even further the ego's high-level control over them. ■

sense of touch and the suction cups on their arms are equipped with chemoreceptors, meaning they can *taste* whatever they are handling. I've heard humans complain about the feeling of shaking hands with a neo-octopus; well, you should hear what the cephalopods say about the taste of human hands.

One thing that many transhumans find odd or unnerving about neo-octopi is that their arms have minds of their own—quite literally! These limbs are packed with neurons (over two-thirds of the neurons of baseline octopi are in the arms) and have a number of complex reflex actions that they engage in without control or input from the ego. While neo-octopi can of course control their arms as desired, when the brain isn't issuing high-level commands to them, the arms simply do their own thing. In neo-octopi culture, this limb autonomy is an accepted fact, and never a cause for embarrassment, though I imagine it also functions as a convenient excuse on occasion.

Like neo-cetaceans, neo-octopi are carnivores, surviving on a diet of (faux) seafood. Though all baseline octopi have venomous saliva, this has been eliminated from most neo-octopi germlines. Most neo-octopi can still squirt ink (melanin and mucus) from their ink sacs; this is in fact a popular art form in neo-octopi culture.

Unlike humans and other uplifts, octopi are not social creatures. This is apparent among neo-octopi who exhibit solitary behavioralisms, value independence, and often shirk group activities, despite human socialization. Though they are not complete isolationists, your average neo-octopi simply prefers to live and work alone, and may chafe if forced into group social situations.

NEO-PIGS

It may seem strange that transhumanity chose to raise up pigs. *Pigs*? The creature that gives us ham and pork chops and *bacon*? Surely that can't be right, can it?

It is.

Pigs are actually excellent candidates for uplift. They are omnivores with a long association with humanity. Scientific studies demonstrated that swine were smarter than dogs and capable of abstract thought. When given a symbol the pigs could remember it hours later. When trained to execute a voice command, they remembered the trigger words *years* later. They exhibit complex social lives, including caring for their young. And there was even some evidence that they were more focused in their attention than chimpanzees, perhaps because of the swine's long association with humans. As previously mentioned, pigs were also heavily used in the early biotechnology days for growing organs suitable for human transplant. Scientists were already making pigs more human so that humans could use their parts.

Which only left the little matter of the pig being a food animal.

This had the potential to be a disastrous. Would neo-pigs resent the fact that their ancestors were a major food source? Would humans be able to interact seriously with a more advanced form of their morning meal? How would religious humans who considered pigs to be unclean react? These issues were enough to keep Earth-bound labs from investing too heavily on pig uplift, but out in the solar system, free from legal and ethical constraints, the hypercorps moved right on ahead. Fortunately, many of these issues are overstated. It wasn't uncommon for humans to eat dolphins, octopi, or even apes in the past, but that had very little effect on their uplift. Most uplifts consider that the past anyway, and don't see the point of holding a grudge. Due to the loss of farm stocks during the Fall, most meat today is either vat grown or produced by cornucopia machines. The neo-pig has been substantially modified, so it's quite a different creature from its forebears. Of course, that hasn't

WHY NO NEW UPLIFTS?

Anyone who's been keeping track realizes that no new species have been raised to sapience in over two decades. Why the break, especially when so many were uplifted in the three decades just prior?

The answer is complex and resides in many factors. The Fall and reconstruction sidelined research and consumed resources. Many hypercorps invested all of their efforts into particular species, requiring significant effort to retool. Even after success with a new species, decades of fine-tuning were required to perfect the process. Many switched to providing services and continued upgrades to the uplifts already raised. And so on.

The major reason, however, is simply that all of the low-hanging fruit had been plucked. The majority of species whose intelligence level was in the range of transhumanity's capability to raise to full sapience were modified and uplifted. All of the animals in the tiers below this required far more effort—for now, they remain outside of transhumanity's reach. As improvements are made with various smart animal species, however, it is only a short time until we welcome some new species to the sapient ranks. The race is already on to see which will be next. ■

stopped the bacon jokes that get tossed their way, but everyone has their cross to bear.

Pig uplifts were raised from a variety of domestic pig strains. Neo-pigs walk upright like humans, thanks to a restructured skeleton and musculature, and stand just shorter than human averages. Some of the germlines still have trouble with bipedal balance I'm told. Transgenic hands and feet replace the hooves. Males grow tusks from their lower jaws, though it is common practice to file these down. Females retain ten or more teats for feeding their young. Some neo-pigs have a vestigial tail, though this has been removed in most germlines. Their sensory organs are roughly equivalent to baseline humans. Transgenic vocal systems enable speech.

Neo-pigs are not nearly as widespread as other uplifts. The current population is under two thousand, clustered mostly in a few specific colonies. Over half are corporate indentures.

NEO-NEANDERTHALS

The story of *Homo neanderthalensis* may be the strangest of all. They are the only uplift species that was resurrected from extinction. Neanderthals were a lost cousin of humanity, a hominid that didn't make it. They lived from roughly 300,000 to 25,000 years ago, when they literally vanished from the face of the Earth. Archaeological findings suggest that the neanderthals were geographically concentrated in the Middle East and Europe, until the cro-magnon humans either wiped them out or out-competed them. Neanderthals were very similar to primitive humans, and it seems likely they were just as intelligent; their brains were actually larger than those of cro-magnons. Neanderthals buried their dead and included flowers and tools in the graves, a sign of ritualistic and abstract thinking. More importantly, it was a sign of love. You don't bother to prepare someone for an afterlife if you don't care for them. The discovery of hyoid bones in baseline neanderthals suggests they could speak. Neanderthals painted caves, crafted musical instruments, and carved figurines. So: families, religion, art, music, and language. Sound like anyone you know?

Like many other long-dead species, DNA recovered from fossils raised the possibility that neanderthals could be brought back. More than any other species, this issue was contentious. Not only were neanderthals potentially intelligent, but they were a species that had competed with humans. It was highly possible that humans had driven them to extinction.

While others debated on Earth, a small hypercorp named New Day quietly acquired genetic samples from multiple sources and went to work in an offworld lab. Unlike other resurrection projects, New Day was not interested in bringing baseline neanderthals back—they went right for the money shot and pursued neanderthal uplifts. A few years after the Fall some evidence came to light that New Day had birthed and even raised some baseline neanderthals for testing purposes, but these were all terminated at young ages. New Day, of course, denies the charges. Seek the evidence yourself online if you choose. More to the point, at this time baseline neanderthals remain extinct; none living are known to exist. Neo-neanderthals, however, are alive and well.

As it turned out, neanderthals required surprisingly few modifications for uplift. A few cognitive enhancements brought their minds in line with the brains of modern humans. Physiologically they required little upgrade. Neanderthal bodies are sturdier and more robust than humans, with stronger arms and hands. They seem to have a natural gift for music, perhaps augmented by New Day's cognitive engineers.

As the most recent addition to the uplift family, neo-neanderthals are limited in population and distribution, numbering less than a thousand. They are primarily clustered in the habitat of Moustier and among New Day facilities. The oldest neanderthals are just over 25; most are significantly younger.

SMART ANIMALS

Not all animals are suitable candidates for uplift. To date, the only creatures that have been successfully uplifted are those who had already taken a few solid steps from sentience towards sapience on their own. Of all of the animal species that existed on Earth, few more than a dozen were of viable enough intelligence that they could be modified to human-level cognition. All of the neuroscience at transhumanity's disposal is not enough to elevate canines, bears, horses, badgers, snakes, sharks, or platypi to the level of thinking apes. The amount of genetic rewiring and biological modification to do so is simply beyond current technology.

This doesn't mean no one is working on it, of course. Right now, all over the solar system, thousands of animals are serving as living test subjects in the genetic arms race to create the next new sapient life form. I know syndicates that have ongoing betting pools, if you're interested. My money's on dogs beating out cats.

There's no reason you have to go all the way to uplift, of course. It's possible to enhance an organism without doing the floor-to-ceiling neural and physiological redesign that uplift entails. Many of those animals that are well-adapted to human services—or servitude, if you care to think of it that way—and who are relatively bright have already been elevated to "smart animal" status. Smart animals include any critters who have been modified for greater intelligence. Though none of these are (yet) capable of passing the Advanced Sapience Test, many of them are significantly more intelligent than their baseline counterparts, and some have even been boosted to the cognitive equivalent of a human toddler. The smarter ones understand verbal commands and can sometimes communicate back using primitive vocalizations or sign language.

Aside from dogs and cats, humanity's primary traditional domestic animals and companions, most smart animals are elevated because of their utility. Creatures that can provide some useful services, whether that be guarding, cleaning up, policing, agricultural work, and so on are more likely to be enhanced. After all, many of the groups behind these uplift projects are hypercorps looking to profit. To them, these animals are a product, or possibly a future indentured workforce.

Smart animals are used throughout transhuman society, just like any tool. Ironically, they are more readily accepted than uplifts because it's clear they still remain on the animal side of the animal-people divide. Even biocons accept the use of smart animals, though they demand limits on the cognitive abilities these animals are engineered to have.

Many smart animal species are enhanced with other modifications, both genetic and cybernetic. More intelligent breeds are equipped with specialized mesh

SWARM CATS

A popular pastime on scum swarms that has recently been gaining in notoriety is the practice of raising and competing so-called "swarm cats." Among the scum, these animals are bred both for companionship and competition. The refusal of the scum to render their creations sterile has meant that a sizable population of swarm cats has developed in various scum barges and swarms—and on many of the habitats they visit.

The animals themselves are chimeric smart cats, heavily modified using open source biotech and genetics to make the biggest, smartest, and meanest feline you can get. Swarm cats entered in competitions must have at least 51% of their genome drawn from animals in the suborder *Feliformia*, which means not only large and small terrestrial cats but also mongooses, civets, and hyenas. The remainder of the genetic makeup can come from anything the engineering party believes will make for a better competitive animal. Non-competitive germlines fall into the category of whatever-the-hell-the-scum-feel-like-today. On my last trip to a scum barge, I saw one that looked like a Siamese house cat with four eyes and purple bioluminescent fur, and another swarm cat that was more like a snow leopard with armadillo skin, six chitinous legs, and a trio of whip-like cybernetic tails.

Competitive swarm catting has two elements. First the cats race through an obstacle course that measures their agility, speed, strength, and problem-solving skills. The cats are most often raced in the more dangerous and disused portions of the ship, creating a true test of their survival skills. The obstacles and tests are clever and sometimes deadly. I saw one where the swarm cats had to figure out how to squelch a fire that blocked access to a tunnel they needed to get through, and another that required them to cross a gap between airlocks exposed to vacuum. The second part is a show portion where the animal gets displayed and performs tricks. In typical scum fashion, this is more like a circus sideshow mixed with appreciation and evaluation of genehacking ingenuity.

Swarm cats can also make excellent guard animals and will often bond to their handlers, using their unique skills to protect them. Many scum barges have growing populations of "stray" swarm cats that are cared for and looked after by the entire ship. ■

inserts so they can be tracked and issued remote commands; a controller AI helps keep the critters electronically leashed. Others are given enhancements appropriate to the animal's utility purposes, or to enable better control in a habitat environment through pheromonal cues, scents, sounds, etc. Some are equipped with puppet socks, enabling their handlers to remotely control or jam them like biological robotic drones.

SMART DOGS

Man's oldest and most loyal companion, *Canis familiaris,* has gotten a makeover for a new age. Enhancement represents the first change in the human-canine relationship since dogs slipped into the circle of firelight 100,000 years ago. Modern dogs come equipped with an artificial larynx and the intelligence of a two-year old human child. They can talk, with an average canine vocabulary of twenty to thirty words. They are able to obey simple commands and express simple concepts: danger, hurt, happy, hungry (that one comes up a lot), etc. Many dogs (especially guard dogs) are fitted with mesh inserts, so they can communicate with their masters remotely. For the dog, it feels like they have the voice of their master in their head. (Yes, *master*—these are *not* uplifts, remember.)

Aside from their role as human companions, dogs have always served the role of guardians. Enhanced canines are a favorite of security corps, being comfortable around humans, easy to train, and well adapted to security duty. Their sense of smell can also be exploited to track targets, detect substances, or warn of other threats. And more than anything else, they're *loyal*. Guard dogs are commonly geared up with special implants, from bioweave to enhanced vision or muscle augmentation. Most popular is diamond teeth, capable of ripping through flesh, bone, and even light armor. Facilities that use guard dogs make ample use of puppet socks to coordinate the dogs' actions when needed.

One thing to note about dogs is that they are not particularly well-equipped to handle microgravity. As a consequence, few are found on zero-g space stations. You're more likely to find smart dogs on planets, large moons, O'Neill cylinders, or toruses.

SMART CATS

The relationship between man and cat has never been quite the same as man and dog. Dogs are grade schoolers who worship their fathers, who believe they can do no wrong. Cats, on the other hand, are teenagers. There is a relationship, there may even be love, but ladled over all of it is a heavy dollop of contempt. One almost wonders if somewhere cat scientists aren't trying to uplift *humans*.

Enhanced cats often have similar hardware to smart dogs—artificial larynxes, mesh inserts, and all the rest. Supposedly they're smarter than dogs (equivalent to a human three-year old), and their vocabulary is on average fifty percent higher (thirty to forty-five words)—though they almost never respond to commands. Sometimes they *do* respond to warnings. It may sound like a fine distinction, but then living with a cat is all about dealing with fine distinctions.

Aside from companionship, smart cats are sometimes used for gathering intel. They are quiet, small, agile, and well-equipped for seeing in near-darkness. It's surprising how often people will overlook a "stray" in a run-down neighborhood. They serve quite well as living recorders, streaming their sensory input over the mesh or dumping it to implanted storage. They can work quite

effectively even outside of direct human supervision. Some germlines have elongated fingers and thumbs on their forepaws, enabling limited tool use. Cat burglars literally exist.

Like dogs, cats are not well-adapted for microgravity and so are rare on zero-g habitats. They are a lot of fun to watch in low-grav stations, however. I've seen cats on Luna make some impressive leaps.

SMART MONKEYS

Dogs and cats are wonderful, but they have certain disadvantages. First off, they are not as bright as they need to be for really complex tasks. They're not stupid exactly, but they aren't what you'd call college material, either. They go a fair way just on instinct and limited enhancements, but at the end of the day there's more yet to go. It's not just the brain issue. It's not even *mostly* the brain issue. The bigger issue is how poorly adapted they are to microgravity.

On the other hand, primates do very well in microgravity. Monkeys are used to climbing trees, swinging on vines, flying across empty space. They do all those same things in zero gee, they just don't have to worry about the possibility of *falling*. And as a bonus, they're clever little buggers, too.

The two monkey species generally favored for enhancement are macaques and spider monkeys: bright, lively creatures that can mass anywhere from ten to fifteen kilos and will generally live into their thirties, making it economical to enhance them. Though if you want an enhanced monkey for security, most people turn to the forty-kilo baboon.

Monkeys are often used as servants. Like dogs and cats, they are typically given larynxes and mesh inserts. Intelligence and vocabulary vary by germline. Smart monkeys are very popular as companions in neo-hominid communities. They are also used as couriers, spies, performers, bar backs, and thieves.

Security baboons are bred for aggression and size. They are often fitted with armor and shock batons. Bars use them as bouncers and they are heavily used for crowd control and general backup by police on Mars. Some owners inject their baboons with a cocktail of hormones and neurotransmitters known as kong—usually a mix of adrenaline, testosterone, and monoamine oxidase, an enzyme that breaks down the neurotransmitter serotonin. This makes the baboons edgy and extremely aggressive. It's also bad for the ol' brain chemistry and circulatory system. Baboons subjected to this kind of treatment usually die a decade earlier than baboons raised under more standard conditions.

Baboons have proved to be good at crowd control on Mars, but that effectiveness comes at a price. Once you turn them loose, it's nearly impossible to rein them in. For this reason the aggression cocktail has to be managed carefully. If an enemy releases it at an inopportune moment, the baboons may very well turn on their handlers.

ANIMAL PODS

Some animals are not suitable for uplift, but their bodies are useful enough to consider creating as pods, particularly if modified for extra utility. These are primarily used as biological androids, operated by an AI for specific tasks, though they are sometimes adopted as morphs by transhumans as well. Novacrabs are the prime example of this, favored for their durability, multiple limbs, and ability to operate in difficult environments, particularly vacuum. Pods created from wolf, tiger, and bear stock have been deployed for security purposes and sometimes even military action. Hypergibbons have been widely adopted as a more aesthetically pleasing alternative to robots in neo-hominid communities, also being useful for neo-apes who want a primate morph that is quick to sleeve into and evacuate. Other less common and sometimes strange pods can be found throughout the system, particularly in the hands of the idle rich, adventurous, or weird. ■

SMART RATS

These upgrades of the common Norwegian rat are clever and dexterous, and they easily fit into a pocket or hood. Think of a smart rat as a little assistant that can dart out and drop or pick up small objects or papers, manipulate devices, fetch you a drink bulb, or sabotage equipment. The portability of rats is a major advantage. They are also harder to detect than cats, dogs, or monkeys. They don't do well in micrograv habitats, though some germlines are equipped with grip pads, enabling them to scurry along interior surfaces.

Smart rats can't speak and are not usually equipped with mesh implants, except cheap spimes that track their location and health. The exception is rats used for spying or infiltration, who will be equipped with recording or transmitting sensors. Their main use, however, is for janitorial services and pest control in habitats. Their behavior is controlled with a complex set of chemical cues.

OTHER SMART ANIMALS

Many other animals have been gifted with enhanced smarts. These range from smart pigeons, used as couriers and eavesdroppers, to the smart horses and camels deployed as pack animals for gatecrashing missions. Some smart animals with no particular utility as servants, partially uplifted at great expense, are favored by the rich, who delight in displaying unusual smart pet companions as expensive showpieces.

UPLIFT SPECIALISTS

You can find almost as many opinions about uplifts as there are people in the solar system. There is prejudice and indifference, of course, but there are also those who consider uplifts interesting as a tool to exploit or because the very idea of uplift fires their imagination. You will find the latter evenly distributed among the various organizations that have a hand in bringing uplifts into existence. To some, uplifts are a product or resource; to others, uplifts are a scientific wonder and living treasure to be cherished.

HYPERCORPS

It was the hypercorps that drove the research that first brought uplifted creatures into the universe. Many uplifts look upon the hypercorps as dangerous and self-centered parents. They are not well loved, but oh, how hard it is to break those family ties. A majority of uplifts still work for hypercorps in conditions that range from privileged employment all the way to de facto slavery. The precise relationship between hypercorps and uplifts is as complex and varied as the uplifts themselves.

It is important to consider that for the hypercorps, uplift is a business. They engage in it in search of profit. Some see it as a testing ground for procedures that may be marketable to transhumans seeking cognitive upgrades; much of what is learned in enhancing animal minds is applicable to humans, or may be in the future, and it is considered more ethical to refine the practices on non-humans first. Others consider themselves manufacturers of biological products to sell to consumers, whether they are making smart rats or cloning morphs. Most hypercorps that actually birth, raise, and socialize uplifts see their work as self-supporting, as they are growing an indentured work force that will pay back their costs in labor for decades to come. Others view their efforts as a sound investment, building a new consumer base to which they can sell tailored products, from specialized consumer goods to genetic service packs or morphological and cognitive upgrades.

In standard hypercapitalist style, there are thousands of hypercorps engaged in some aspect of uplift work, from small three-person mostly virtual outfits to monolithic near-megacorp size businesses like Somatek. The vast majority are small and specialized, focusing on specific aspects of the uplift process—cognitive research, transgenic splicing, in vitro fertilization, child-rearing, socialization software, aptitude testing, etc.—and working with other small hypercorps and partnerships as part of a larger gestalt process. They each draw from a massive pool of freelancers who sell their skills to individual projects. Certain genehackers, neuroscientists, and zoological psych specialists with good reps are in high demand for their contracted services.

Among the hypercorps and consortiums that actually grow new uplifts or work with existing uplifts to reproduce, the majority saddle their progeny with some sort of debt for the privilege. The terms vary, but frequently require a period of indentured service once the uplift reaches sexual maturity. They may treat the uplifts as property, as contracted workers, or if the uplifts are lucky, as valued citizen-employees. Some uplifts have the option to buy out if they can find the money or a sponsor, but most are contractually obligated to work. Uplifts raised in sovereign hypercorp habitats have no recourse to laws or rights; they are at the hypercorp's mercy. Within the Consortium, indenture debts are considered perfectly legal, though they have faced challenges in some habitats and in other jurisdictions. A major part of the justification for this practice is that uplift procedures and genetics are considered intellectual property. Patents are levied against almost every modified base pair in nearly every uplift that ever drew a breath. The hypercorps point to the trillions they have invested in uplift technologies and claim the debt bonds are justified to recoup their investment. The argument that patents must bow to the public interest holds little weight among the Consortium and Lunar-Lagrange courts.

Talk to the CEO of any of the hypercorps that employ contract uplifts in their workforce (which is to say all of them), and they'll give you compelling reasons why what they're doing isn't slavery, but opportunity. After all, without corporate capital uplift research would be decades behind where it is today. Many of the uplifts currently alive would never have been born. Uplift advocates, mercurial activists, and autonomists claim that lives are at stake and point out the immorality of treating the body of a sapient being as intellectual property, but in hypercorp jurisdictions these arguments fall secondary to commercial interests.

Though many of the major uplift hypercorps are easy to identify—**Provolve, Cephala, MindUp,** to name just a few—some deserve special mention.

SOMATEK

When most people think of a hypercorp associated with uplift, Somatek is the first name to come to mind. Their logo was branded indelibly in the public mind when they transformed a chimpanzee from *Pan troglodytes* into *Pan sapiens*. Somatek's pioneering work continues to be a driving force in uplift science and affairs.

I have actually met the uplift poster child, Jumbles the chimp. He is still a public figurehead for Somatek's work, albeit a controversial one. He seems to genuinely support the corp's initiatives and believe in their mission, but there is much speculation about his loyalty and questions regarding the services to which Somatek contractually bound him when he was just a young chimp. In a very frank conversation, he explained to me his opinion that Somatek was more complex than most people realize. On one hand, the mercurials and pro-uplift extremists condemn Somatek's methods,

GUERILLA UPLIFT

To: <Encrypted>
From: <Encrypted>

Thanks to the tip you gave us, we hit that exhuman lab out in the Main Belt last month. The mission was a success. We managed to stop production of that nasty little plague that had been cropping up in the Martian hinterlands. We wiped their facilities clean.

I don't think dealing with exhumans is ever easy, but after seeing some of the things we saw in their labs … well, let's just say I'm still having nightmares. In particular, we ran across some—I hesitate to call it research, when it seemed more like an atrocity—projects of theirs. Though it's sometimes hard to tell what they're hoping to achieve, this one seemed different. It wasn't about transforming their posthuman selves into something else, and it wasn't about whipping up biowar plagues to mess with the rest of us either. As far as I could tell, it was a project to create a new species of uplift. Not just a particular species either—my best guess is that they were splicing together traits from a few different species to come up with something new. It was a horrible, gory mess.

We logged evidence. Some of it seems to indicate this was a satellite project, that the heavy research was going on elsewhere. I'm considering passing it along to some of our friends who may be interested. I just wanted to check in with you first, to see if you've heard of anything in this vein?

I sincerely hope you haven't. I wish I never had.

particularly forced indenture and the focus on human standards of cognition and socialization. Somatek rigidly controls uplift genetics and reproduction. On the other, Somatek is is considered a champion for uplift causes—even by many uplifts—and they have adopted positions that are considerably more liberal than many of their competitors. By comparison, their indenture terms are shorter and more lenient. Somatek likely employs more uplifts than any other corp, many of them staying on after their indenture period ends. These uplifts participate at all levels, with a number engaged in creating new uplifts, and some even serving as advisors to Somatek's board.

Somatek's uplift experimentation began decades before the arrival of Jumbles. Uplift research was a natural outgrowth of the pharming work they were already doing, redesigning plant and animal genomes to produce useful biological compounds. Their first commercial successes were making rhesus macaques whose blood conferred immunity to the entire family of deadly hemorrhagic filoviruses—Marburg, Ebola-Zaïre, and Ebola-Miami—and various strains of hogs that grew human organs for transplantation. These were followed by more discoveries. Plastic brain tissue from sheep. Insulin from sunflowers. Neuropeptides from carp. The whole natural world is filled with biofactories designed to produce a complex set of organic chemicals; Somatek just hijacked the machinery for their own use.

All scientific and commercial incentives aside, if you view the old interviews and press footage from these early days, you get a sense of the real reason Somatek scientists pursued uplift: *Because they could*. When you have that kind of power over genetics, it's only natural to see what you can do with it. Talk to any of the scientists on that initial team that first achieved uplift and you can see it in their eyes, hear it in their voices. They did the work of gods. They not only created new life, but life that was self-aware and that could talk back to them.

In the early days, back when Rael Duvalier was the charismatic figurehead and agenda-setter, this manifested as a patriarchal attitude. Somatek personnel saw themselves as benevolent father figures, raising their children so that they may one day be productive members of society. It just so happened that there was more than a bit of condescension there. According to Duvalier's vision, uplifts were special needs children. Even as sapient adults, they would need humanity's guiding hand for decades, maybe centuries to come. They were inferior to humans, not yet mature enough to grasp the complexities of society and culture, and so required humanity's oversight. This attitude is not so uncommon among Somatek's rivals even today.

Perspectives change over time, however. After the Fall, transhumanity found itself on a new road. The backlash against AGIs also spilled over onto uplifts; if transhumanity could spawn intelligent computer monsters, why not intelligent animal monsters? Already controversial, uplifts and their proponents were once again put on the defensive. By this time, however, Somatek's personnel had spent decades working alongside uplifts, raising many of them from children to adulthood. Numerous uplifts worked within their ranks. They knew in their hearts that treating uplifts as animals or monsters was wrong. In a surprise move, Duvalier and many of his supporters found themselves forced out of the company. A new corporate culture was spawned, one that was friendlier to uplifts. In the hypercorp's ranks today you can find thousands of uplifts who believe in the corp. Who *love* the corp. I'm not repeating stories I've heard, I've spoken with Somatek workers myself.

As you might expect, the feelings of uplifts outside the Somatek family circle are considerably less charitable. Many uplifts hate Somatek and will have nothing to do with them or anyone who works for them, even *subcontracts* for them. Somatek is a favorite target of uplift terrorist splinters, which is the reason that Clever Hands is one of the most heavily defended installations on Luna. Uplifts that voluntarily work for Somatek are considered Uncle Toms, sell-outs who help oppress their own kind.

Aside from their relations with and attitude towards uplifts, Somatek continues to do well as a business. Notably, they are not a member of the Planetary Consortium, though they do work with many Consortium interests. Most of Somatek's habitats and holdings participate in the Lunar-Lagrange Alliance or exist independently. Clever Hands (a play on the name of a purported talking horse) is home to their largest research, exowomb, and crèche facilities.

New Day

New Day is notable as the hypercorp responsible for simultaneously resurrecting and uplifting neanderthals. Though the ethics of recreating one of humanity's closest cousins and their decision to only raise neo-neanderthals were questioned and criticized at the time, both issues are largely moot now that a substantial neo-neanderthal population exists. Headquartered at Moustier in the Martian Trojans, New Day continues to breed and improve on neo-neanderthal germlines. Unlike many other uplift corps, New Day imposes no ownership claims, breeding restrictions, or indenture contracts on their progeny—once they reach the age of 16. Until that point, neo-neanderthals are monitored, tested, and raised in New Day-sponsored communities. They do, however, place a lien on each uplift, collected as a percentage of their earned income, until they repay the costs of their upbringing. Given that the oldest is just over 25, most neo-neanderthals are still under New Day's supervision, and most remain indebted to the corp.

According to the rumors, New Day is hard at work on developing a morph that is a perfect hybrid of neanderthal and human genetics. The idea seems to be to create a sleeve in which neo-neanderthals can better fit in to transhuman society while retaining part of their heritage, while also giving an option for transhumans who want to play at being part "cave man" for a while (and yes, neo-neanderthals consider that term a pejorative, except for those that embrace the term and own it). In the deep currents of the mesh, I've also heard that New Day is interested in uplifting some of humanity's other extinct cousins, such as *Homo floresiensis* and the Denisovans. They lack the genetic material and information they need for this project, however, as much was lost on Earth during the Fall. Supposedly New Day has an open bounty for any scavengers that retrieve the information they need from Earth.

Darwin's Children, Incorporated

DCI is the largest hypercorp wholly owned and operated by uplifts. Its focus is on providing the tools and adaptations for uplifts to function in transhuman society. It designs blueprints for and manufactures translators that convert dolphin whistles and whale song into human speech, servos that allow parrots and octopi to manipulate equipment they don't have the strength to operate on their own, drugs that compensate for protein deficiencies, and a thousand other products. If there's an uplift somewhere that needs a special tool or modified device, DCI has likely either designed one itself or contracted with freelancers to do so.

Lest you think DCI is all about uplift love, don't lose sight of the fact that they are a ruthless for-profit business. The neo-orangutans behind the outfit are cold-hearted capitalists whose driving ideology seems to be to raid the bank accounts of their fellow uplifts before some humans do. Greed is not solely a human trait.

Nevertheless, DCI recognizes that the more rights uplifts have, the better consumers they will be. Based in the Morningstar

Incident Report: Escaped Neanderthal

To: <Encrypted>
From: <Encrypted>

I talked to the sifters again. They still claim the murder victim was a neanderthal, named Willamina. They're not sure where she came from—they claim she simply showed up in their mobile camp one night, just a few hours before they had to move to keep ahead of the terminus. She wasn't the best at communicating, they said. According to her story, she escaped from some corp facility where they were breeding neanderthals that were intentionally dumbed down. They said it sounded like an operation to create a new set of low-IQ servants, with no more rights than your average robot. They suspected some heavy psychosurgical mods. I guess the corp was finding it much more difficult to make a dumb-but-still-sapient servant than anticipated, since she got away. They were keeping her safe, teasing out details of her story, looking forward to taking it public with a big splash. Those sifters will jump on anything that gives them a chance to stick it to one of their corporate neighbors. That's when she disappeared. They later figured out she'd been immobilized and pushed out an airlock, left to roast with Mercury's sunrise. She had no stack.

I've done some preliminary scouting in the area they found her, looking for signs of a secret corp installation. No luck yet, but I'll widen the radius. I have a feeling that even if I find something, it's going to be cleared out and abandoned.

Constellation, DCI has been instrumental in lobbying the fledgling government to pass legislation protecting uplift interests. They also contribute heavily to uplift rights groups active in the Consortium.

Feral Robot

Feral Robot is a small, five-person virtual company, all uplifts, scattered throughout the solar system. Despite their size, they are large in impact. Feral Robot's personnel are system-class robotics engineers. They specialize in producing synthetic morphs that mimic uplift forms rather than humanoid styles. Though mass-produced by other hypercorps, Feral Robot were the ones who designed the takko morph, the first fully synthetic uplift design made available for commercial usage. The design sacrifices little of an octomorph's natural dexterity and utility but adds a greater degree of durability and the advantages of a fully synthetic body. Feral Robot is primarily busy with custom-order models, but word is their next project is to develop a synthetic avian morph specially adapted for the Venusian atmosphere.

Cognite

Whereas many uplifts hate hypercorps like Somatek, Cognite they *fear*. Cognite is known and respected for their cognitive enhancements and psychosurgical procedures, but they are also infamous for their research into the dark and strange corners of the mind—and they don't just toy with human minds. Uplifts are interesting primarily because their brains are not human in origin.

Though Cognite offers little in the way of uplift research or products or services geared towards uplift consumers, there is no question that they experiment with uplift cognition. Experimentation requires altering an experimental subject and observing the variation in results. Now this doesn't sound so bad when you're talking about rolling balls of different masses down ramps of various inclines, but what if you're talking about slicing into living minds?

If rumors are to be believed, Cognite has numerous side projects dedicated to modeling and modifying uplift minds according to varying criteria. Things like modeling schizophrenia and autistic spectrum variations in different uplift breeds. Things like repeatedly inflicting mental stress on uplift forks to measure psychotic break points. Things like raising uplifts with non-human models of mind. That's right—the dream that many mercurials have of non-human mindsets? I'd bet money Cognite is already far down that road—and most of us wouldn't like the results.

Non-Hypercorp Specialists

Not all of the uplift research in the solar system is in hypercorp hands, of course. There are numerous autonomist collectives pursuing their own studies and projects, not to mention a few put together entirely by mercurials. These projects are usually less exploitive than hypercorp affairs, though there are some exceptions in brinker enclaves.

Fortean

The exomoon of Fortean, accessed through the Fissure gate controlled by the Love and Rage Collective, has proven itself to be a true friend to uplifts and our interests. Several of the new biomorph and pod sleeves specifically designed for uplifts were first fabricated on Fortean. Many of these designs are neogenetic, pushing the limits of what can be done with our current gene-hacking capabilities. Fortean has been one of the few places to address the issue of utility when it comes to morphs. The simple fact of the matter is that if you are human you have dozens of potential morphs and shells to choose from, depending on where you live and what you do. For the vast majority of uplifts, the choice is between a morph very much like the one you were uplifted in or one of the human-form morphs which many of us find less than satisfactory. Fortean has attempted to rectify this situation by designing several special-use uplift morphs for our people.

The Kisilev Open Source Uplift Genetic Library

Located on Ceres, this institution works to untangle the complex web of uplift genetics. Sponsored by the argonauts, it is a fine example of the belief in open source information and technoprogressivism. The ultimate goal of the library is to return control of uplift biology to the uplifts themselves. The library accepts small resource payments to cover its operating needs, but all of the information in its data banks—physiology, reproductive biology, genetic coding errors, psychology, brain scans, more—is available to all for free. The library does ask uplifts who use its resources to contribute any data they might have—meaning personal data, stripped of identifying factors. Even the most destitute uplift often has a lifelog, aptitude test scores, and possibly personal health records and genomic data at their disposal. Every uplift's experiences and medical problems adds another data point to the wealth of knowledge already accumulated by the library. Almost all of the autonomist uplift concerns make heavy use of the library and contribute their own data.

Though the library operates according to local jurisdiction laws, in areas that do not prohibit it they also offer a wealth of pirated proprietary genetic data. This factor remains a sore point in the library's dealings with inner-system hypercorps.

Though they don't speak of it directly, the Kisilev library also sponsors a unique grants program through some trusted intermediaries that rewards enterprising individuals and groups who are able to acquire sequences or samples off their "most wanted" list. And I hear they're not too particular about whether the results come out of a lab or are obtained through less scientifically rigorous means.

Uplift Social Issues

Integrating over a dozen brand-new, intelligent, but non-human species into the transhuman family was not an easy journey. The legal battles began even before the first uplift embryo was created and continue on in numerous forms today. Culturally, the impact of uplifts has shifted from rejection to celebration to exploitation, and everything in between.

Legal Issues

Simply gaining recognition as intelligent, sapient citizens with civil rights has been an uphill battle.

Personhood

What is a person?

This *seems* like an easy question, but appearances can be deceiving. Throughout the long sweep of human history, the answer to the question of what a person is has continually changed. Was a woman a person, or was she a piece of property? Or was she even a *liability,* something that had to be compensated for with a dowry before a man's family would agree to take her on? Was a man alien to their immediate culture a person? Not if you were of African descent in the United States of 1861 or if you were a Jew in the Germany of 1938.

As time marched on, human society liberalized and the definition of personhood broadened. By the end of the 20th century, in most Western nation-states at least, a consensus view emerged that implicitly extended the definition of personhood to all human beings. Seems reasonable. Problem solved, right?

Not quite.

That definition of personhood only seems stable until you ask a second question. What makes a human a human? To put it another way, what makes a being sapient? While religious-minded people had easy answers about god-given authority to shape the land and slaughter the beasts, philosophers and scientists struggled with the answer. In fact, the more humans studied other creatures, the harder it was to say what sapience was and why it didn't apply to animals. The conversation went something like this:

A: *Homo sapiens* is sapient because they are tool users.
B: But sea otters use stones to crack open mollusks.
A: Those are rocks the otters just found lying around. Only humans *make* tools.
B: Except for wild chimpanzees, who modify twigs for termite fishing.
A: But that's just instinct. Humans are innovators. Animals don't innovate.
B: Ever set up a bird feeder designed to keep squirrels out?
A: Sure.
B: Do those things ever work?
A: Well …
B: Doesn't the squirrel *always* find a way to get the food?
A: That's only because squirrels are *evolved* to break into bird feeders!
B: *Really?*
A: Then it's language. Only humans use language.
B: That's the worst example yet. Dolphins and whales use a quite sophisticated language. Bonobos and gorillas have shown an ability to understand human language, even inventing new words. Really any animal that can accept human voice commands has at least a rudimentary understanding of language. Even simple songbirds compose their songs according to linguistic rules.
A: All right, but it's something. It has to be *something*.

By the late 20th century, human science was beginning to bump up against the possibility that it wasn't really something, after all. Maybe humans and animals didn't belong to two distinct groups, but *Homo sapiens* was just one species placed on a long continuum of intelligence. Sure, humanity was on the smart end of the stick, but the real question was, just how smart were their neighbors?

Why did it matter? Because once you start acknowledging other creatures as intelligent, you have to start thinking about the implications. Did other intelligent beings have rights? Were humans ethically bound to avoid causing them pain? Should these animals then be exempt not only from hunting, slaughter, and experimentation, but should they be *protected?*

This increasing awareness of animal intelligence began to filter through Western culture just as women's suffrage, the repeal of slavery, and the expansion of civil rights had before. Animal welfare societies sprang up. Anti-cruelty laws. Endangered species lists. Restrictions on animal testing. Restrictions on whaling, eventually leading to a ban. By the early 21st century, leftist political parties in Spain and New Zealand had taken the first steps toward an uplifted world: they argued for a legal definition of person that included the great apes. By defining other

KNOW YOUR RIGHTS

Laws regarding uplifts vary widely across the solar system. Smart uplifts will always know the law where they are—and where they're going.

Anarchist Stations: Uplifts are generally regarded as equals in anarchist areas, responsible for themselves just like everyone else. Many anarchists have a decidedly pro-uplift stance, and several groups actively aid uplifts that are fleeing indentured service or otherwise seeking aid.

Extropia: Extropian legalities are entirely based on mutual contracts. According to the legal precepts adopted by Nomic and similar Extropian legal AIs, however, no sapient being may be enslaved by another. This means that in Extropian holds, hypercorps are not allowed to enforce indentured service on uplifts they raise. For most other purposes, uplifts are treated as sapient people just like everyone else.

The Jovian Republic: Uplifts have no rights on Jupiter's Junta moons. They are banned from entering without special exceptions, and they are considered legally equivalent to animals for all intents and purposes. While uplift is legal in the Republic for raising smart animals, it is illegal to research or create sapient creatures. It is highly likely, however, that the Junta itself continues uplift research for its own purposes and potential military applications.

The Lunar-Lagrange Alliance: Often considered the most conservative inner-system power, the LLA holds a stance roughly equivalent to the Planetary Consortium when it comes to uplifts: leave it up to individual habitats. While uplifts typically have second-class status in LLA colonies, there is surprisingly less discrimination against uplifts than in the Consortium, possibly because most Lunars and Orbitals are more concerned about synthmorphs or their rival ethnic groups. Lunar and orbital habitats have been known to honor the extradition requests from hypercorps seeking runaway uplift indentures.

Morningstar Constellation: The Constellation holds the most liberal attitudes of the three inner-system powers. Uplifts are recognized as legal persons by the constitution and accorded the same rights and privileges of other Constellation citizens or visitors. Controversially, hypercorps that raise uplifts are allowed to enforce service contracts or liens for their upbringing, but these are limited by Constellation law to keep them from being too excessive.

The Planetary Consortium: The Consortium largely leaves uplift legalities up to individual habitats, giving each the mandate to apply their own rules. This has led to a wide disparity, from habitats that treat uplifts as property or ban them entirely to colonies where uplifts have all the rights and responsibilities of other citizens. This means that an uplift with Consortium citizenship from one station may find that they suddenly have fewer rights or need a legal guardian to visit a more conservative Consortium habitat. Though the judicial Assembly has made some rulings regarding uplifts that affect the entire Consortium, these have made it clear that member hypercorps have the authority to breed new uplifts, restrict their reproduction, and contractually bind them to terms of indentured service as repayment for their upbringing at a rate they determine. The majority of Consortium habitats consider uplifts to have legal personhood and give lip service to their rights, but in practice they are often treated differently. It is common for uplift reproduction to be restricted and for uplifts to barred from certain positions of authority; some stations even require uplifts to make their nature public on their mesh profiles and to submit to periodic evaluations or extra security monitoring.

The struggle for uplift rights is very much ongoing in Consortium memespace. The simple truth is that there is a widespread culture of discrimination, sometimes institutionalized.

Titanian Commonwealth: Like most other autonomists, the Commonwealth is very accepting of uplifts and treats them as full legal beings. It is illegal to force indentures into service in Titanian jurisdictions. Smart animals are also afforded some basic rights, such as shelter and medical care. ■

intelligent creatures as *persons,* they hoped to extend certain rights and protections that were otherwise reserved for humans.

Now that we have uplifts—who by humanity's own definitions are as intelligent as humans—the issue is more relevant than ever. Almost all societies consider uplifts (as well as many smart animals and non-uplifted creatures) as persons and thus worthy of certain legal protections. Many, however, have not yet taken the next step of granting uplifts (and AGIs for that matter) the same full rights as transhumans. Until this era of institutionalized prejudice is past, uplifts will be considered second-class citizens in many parts of transhuman space.

SAPIENCE

In order to be considered a full uplift, of human-equivalent intelligence, a test was devised: the Applied Sapience Test (AST). This same test is used to analyze and rate AGIs. Initially developed and backed by a coalition of research foundations, corporate interests, and governmental agencies, the AST is now maintained and updated by the argonauts.

The AST is sufficiently rigorous that some humans have failed to pass it. It measures a wide range of aptitudes and factors, including critical thinking, problem-solving, deductive reasoning, creativity, empathy, adaptability, and more. Critics of the AST charge that the test is predisposed towards human models of cognition and question whether significantly alien forms of intelligence would pass.

CULTURAL ISSUES

A good starting point for understanding the cultural challenges uplifts face is the very beginning. When Somatek announced its first uplift success, introducing Jumbles, the news struck like a thermonuclear device. At first it was wonderful. Jumbles was a celebrity. The media hounded him. People flocked to see him. They wanted to hear him speak, touch him. They wanted his autograph, which was awkward because he was still learning his letters. His scrawl looked like that of a six-year old trying to write his name—which wasn't all that far from the truth. Journalists interviewed him and then they interviewed him again, this time in comms-shielded rooms so they could be sure it wasn't a trick. It wasn't.

The media and public attention went on for days. Then weeks. Then *months*.

Somewhere in there, things started to go bad. Maybe it was inevitable that the public would turn once they started to see past the rock-star celebrity and think through the implications. Humanity's relationship with nature had just been radically redefined. The people of the Earth were living in a whole new world and no one had gotten a say in it or even knew the change was coming.

Bioconservatives had been speaking out against uplift for decades, but now they had a real chance to get their voices heard. The right-wing biocons railed against the abomination of nature, the threats posed by integrating animals with humans, the hubris of playing god. The left-wing biocons condemned the immorality of animal research and warned against this leading to a new wave of corporate animal and genetic exploitation. Their arguments were not ignored. Many listened. Governments and politicians listened and enacted legislation.

The biocons weren't the only ones to raise opposition. The uplift of animals brought the whole range of animal exploitation throughout human society into question. Those who raised or harvested animals for food saw the potential for their livelihoods threatened. Corporations that relied heavily on animal testing and experimentation saw potential future roadblocks if animals were given increased protections. Religious masses felt threatened by the idea that an animal could have a soul—or feared the future if it didn't. The starving and disenfranchised poor wondered why scientists were creating new life when so many humans still went without fulfillment of their basic needs.

The initial backlash drove much uplift research underground or offworld. A strong current of xenophobia impaired the integration of uplifts into human society. But technological progress was also exerting its influence. Corporations continued to research uplifts and introduce new uplifted species. AGIs were also introduced, taking some of the brunt of fear and hate away from uplifts for a while. In areas with more technoprogressive views, uplifts began living and working among humans. The news followed these developments closely. Over time, continued exposure to the existence of uplifts—especially living among humans—blunted many fears.

Still, a few unfortunate incidents in that first decade created setbacks. A stressed neo-orangutan was convicted of assaulting multiple people, raising fears of safety around uplifts. A silverback neo-gorilla was convicted in the murder of a rival silverback. Neo-bonobos faced multiple sexual harassment claims—and a neo-dolphin was charged with attempted rape. The biocons used these affairs to fuel their anti-uplift campaigns.

The Fall, horrible as it was, also created new opportunities for uplifts. Many uplifts survived where the corporations that had made and enslaved them did not. The Fall corrupted and destroyed some uplift records, making it hard for those companies to prove they had legal ownership or a right to their contract labor. The disaster also sent millions of infugees streaming away from Earth at the speed of data—some of them uplifted. Many of these uplifts started new lives with new identities. Other uplifts took the opportunity to run away from their self-declared masters.

Where many uplifts had previously been raised in isolated facilities and interacted only sparsely with

transhumanity, the Fall forced many of them into cohabitation. Though this created tension among transhumanity's xenophobic elements, the increased interaction largely helped to alleviate many people's fears as they saw that uplifts were often just like other people—and in some cases less strange than other transhumans.

Assimilation

There is no question that the relationship between uplifts and the rest of transhumanity is growing closer. The xenophobic resistance against uplifts is largely based on fear of the unknown, but as time passes even culturally isolated transhumans see, hear about, or interact with uplifts more frequently. Numerous uplifts have become media icons, and it is no longer unusual to see uplift characters in vids, in political debates, or in the news as regular citizens or contributors. As transhumanity itself changes and evolves, uplifts seem less and less unusual. Given the widespread use of resleeving technology, it is no longer uncommon to find humans in uplift morphs and vice versa. Uplifts are slowly but surely being assimilated into the transhuman family.

There are still challenges. Even among humans who are not outwardly prejudiced, there are those who unthinkingly condone or continue low-level discrimination or stereotyping. Almost every uplift can tell you about humans they have met who claim to have nothing against uplifts, but then go on to treat them as inferior, exhibit extra caution around them, or support politicos and groups with anti-uplift agendas. Humans are often privileged in ways that uplifts are not, and most are not cognizant of this fact. It is not uncommon for humans to be chosen over more qualified uplifts for jobs, for example, or for uplifts to endure extra "random" security screenings. Uplifts are sometimes considered less reliable witnesses for legal testimony, and so on. Even uplifts who have achieved power and influence are sometimes impacted, though these individuals at least have the sway to create a fuss.

Anti-Assimilation

The Fall liberated or separated many uplifts from their patrons. For the first time since the advent of uplift technology, there was a large and growing population of enhanced creatures who were free to assemble, to organize, to think for themselves. Uplift culture evolved rapidly.

Those who fled practical enslavement or inhospitable treatments at the hands of the hypercorps were the least likely to look upon transhumanity with favor. Once they gathered with others who had endured similar experiences, that viewpoint was reinforced. These uplifts were not interested in assimilating into transhuman society; they wanted to forge their own direction. They began rejecting human rules and customs, human fashions, even human *words*. Many of these sapient creatures felt they had something to offer beyond simply aping or parroting human

behaviors. Thus did the first mercurials and similar uplift factions coalesce.

As uplifts cast about for something beyond the domain of Homo sap, they often found common cause with AGIs who similarly advocated a path of self-determination and non-anthropocentrism. Slowly, AGIs and uplifts began to come together, siblings growing up side-by-side in the same dysfunctional family. And so a political alliance was born.

Called mercurials because of their new and changing natures, it isn't a perfect partnership, even to this day. There are many uplifts who fear what AGIs could become if left unchecked (especially those who fled Earth during the Fall.) And since their entire agenda is about setting their own paths, both elements are keenly aware that their individual paths are quite different—and may even have conflicting goals. Some AGI mercurials, for example, feel that transhuman society is far too oriented towards preserving biological life, which they feel is fundamentally inferior, whereas many uplift mercurials see biological self-determination as a foundation of their interests and future. But in the end, uplift and AGI mercurials share many mutual concerns, not the least of which is keeping transhuman hands from controlling their cognitive futures.

The truth is, even many mercurials have issues defining what uplift culture is. Each species has a different take on it, of course, but that's not the real issue. The hard reality is that the individual uplift species are cultural infants. Before uplift, in their baseline animal form, their culture was rudimentary and primitive at best. Ever since uplift, any attempt to come to terms with who and what they are has been eclipsed by the overwhelming influence of human culture. The vast majority of uplift cultural actors are pioneers—they are literally making it up as they go along. In some ways, uplift culture is becoming a battleground. As the mercurials seek to identify themselves and stake their ground, their memes are engaged in an uphill battle against mainstream transhuman culture—and against their own mercurial peers. Though they have their own shared experiences to fall back on, that is not enough on its own. As is usually the case, the best memes will win.

If there's one thing the mercurials have in their favor, it is an explosion of vision. Not only are there new tools for the artist's talented hand, claw, fin, or tentacle—XP, holography, sonic sculpture—but uplifts bring an entire new set of outlooks to the table. Ironically, this has helped to enrich transhuman culture, as much of the mercurials' cultural output

THE CULTURE VOID

Source: Welcoming address by Dr. Kalifa Lulua to an incoming cohort of Uplift Studies students. [Link]

I commend you on being in the forefront of scholars seeking to better understand the rapidly changing forces that shape our world. In undertaking to more closely examine uplift and its consequences, you place yourself at the vanguard of a debate that is raging among some of our most learned and brilliant minds about how uplifts should confront the culture void.

Historically, when a people has freed itself from oppression and tragedy, they have had a past history to fall back on, a shared experience of times before or a long tradition of practices and beliefs. Whether it was former slaves brought to the Americas who were able to reconnect with their African roots or the displaced and decimated survivors of the Holocaust who founded the state of Israel partially on ancient Jewish principles. The histories of immigrant groups all over old Earth, at first reviled but then embraced, is one where these communities found strength in their traditions while learning and integrating into the cultures of their new surroundings.

What then of the uplift? What traditions, what beliefs, what culture existed before the lab? None. There is nothing uplifts have to call their own. For them there is a void, an emptiness of history, of practice, of heritage to build upon going forward.

So the question becomes, where do uplifts go from here? Do they accept the tabula rasa and begin afresh, rejecting all transhuman culture and attempting to create a new social order and tradition organically such as groups like the mercurials advocate? Do they play to stereotypes and take those anthropomorphized traits that pre-uplift humans gave them in their fables and myths as culture and practice? Or do they assimilate and stop looking for a separate "uplift" identity? Do they concede that anything they might come up with is socially constructed and inauthentic and join the rest of transhumanity as just slightly different-looking Barsoomians, Titanians, and Loonies?

These questions, above all else, will shadow your research and shape your work over the years you are here. While they are intensely interesting subjects of academic study for us, we should never forget that they are also very much important to people we live and work with to the point where they will fight, and some possibly die, over them. ■

has been co-opted or commodified for mass consumption. Jungle clubs, once exclusive to neo-hominids, are popping up across the system. Ink painting, once exclusive to neo-octopi, is being taken up by human artists. Though mercurials decry the cultural appropriation, those with autonomist inclinations point out that culture has always been based on theft. Others are glad to see mercurial ideas and practices adopted by humans, feeling that all of transhumanity is enriched by the experience.

THE WORK OF UPLIFTS

One measuring stick for the depth of uplift integration in transhuman society is the professional roles in which they have gained noticeable representation or scored major achievements. Though many uplifts work as indentures, some of them take this work quite seriously and exceed their patrons' expectations. In the outer system, uplifts have proven themselves just as capable at achieving recognition for creativity, innovation, or reliability as their human peers. For some tasks, uplifts are simply more well adapted and are a damn sight better at it than just about anyone else.

SCIENCE

Contrary to those who assume uplifts are inferior in intelligence to their human counterparts, uplifts make brilliant scientists. Part of it is that their minds are *designed*, so they are intentionally built to be smart and methodical. Uplifts were quite specifically bred for genetic traits linked to logic, rigor, and innovation as part of the uplift process. These same cognitive tools were also emphasized as part of each uplift's upbringing, socialization, and education. And who designed these cognitive upgrades and learning courses? Scientists, of course, who were already predisposed towards scientific processes and thinking. It is no surprise that so many uplifts have exhibited aptitudes for scientific work. The apple does not fall far from the tree.

But there's more to it than that. The very nature of uplifts is an advantage in scientific research—that is, their capacity for non-human modes of thinking. Despite being engineered and socialized to think like humans, uplifts come to this position from a different starting point and each species retains some non-human cognitive traits. Uplifts can see around the corners of human logic. More than once, uplift scientists have resolved problems that vexed human scientists by approaching it from their own unique perspectives. The ability to think outside the (human mind) box is key to many uplift researchers' careers.

The evolutionary past of each uplift species also brings certain traits to the table that uplift scientists can use to their advantage. This usually involves exploiting their natural gifts. Neo-cetacean scientists, for example, excel in fields like acoustics, fluid mechanics, medicine, non-Euclidean geometry, and organic chemistry, benefiting from their natural aptitudes with sonar and aquatic conditions and their intuitive sense of space. Likewise, neo-avians have an instinctive feel for complex atmospheric dynamics and are good with languages.

There is one scientific endeavor that attracts more uplift minds than any other—the science of uplift, of course. Raised-up creatures are much sought after as psychologists and physiologists to design processes that reduce both mental and physical stress on uplift subjects. They have excellent insights into the most effective ways to engineer cousin species. And, of course, they make the best minders. While some corporations bar uplift scientists from participating in research related to their own or similar species—citing "security concerns" or "conflict of interest"—others have made successful careers out of enhancing their own phenotypes. Among uplifts, the science of raising up animals is more than just a job; some feel it is a calling.

SECURITY

A significant percentage of uplifts have found work as security contractors. Security companies favor uplifts because they bring a number of useful skills and natural abilities to the table, often meeting certain security needs at a fraction of the cost it would take to hire a human freelancer with an expensive security morph. Neo-hominids, for example, are good operatives for any job that requires climbing and they are typically stronger than your average splicer. Neo-avians have the aerial advantage, are great for recon and surveillance ops, and excel in microgravity. Neo-octopi have natural camo, can hide easily, are more comfortable in zero g than your average transhuman, and can find clever and lethal uses for all of those extra arms.

Since a major element of security is intimidation, uplifts have an advantage in that they automatically strike fear in xenophobic humans. Not that there isn't ample reason to fear a silverback neo-gorilla with enhanced reflexes and a chip on their shoulder. Even humans who aren't openly prejudiced tend to equate uplifts with animals and thus with wild, feral danger. It's a human survival instinct, back from the old days when getting eaten by a tiger was a daily concern. Security corps exploit this to maximum advantage.

There is also the underestimation factor. People often see a club-toting neo-chimp or neo-neanderthal and think "stupid." The fact that uplifts are often just as smart as they are makes them doubly dangerous. That small advantage could give them the critical edge in that tight spot.

When attempting to infiltrate an uplift group, such as a purist terrorist cell, using another uplift is a must. The only choice for counterinsurgency contracts like this is to go native. A human sleeved in a neo-chimp morph is going to have a very difficult time passing muster with *real* chimps. They're just not wired that way.

As it turns out, many uplifts are happy to work security. It is often seen as a better alternative than

SOLARCHIVE SEARCH: THE UPLIFT AVANT-GARDE

Blue Long Fin: This uplifted blue whale is widely regarded as the finest neo-cetacean song stylist in the solar system. Long Fin resides in Atlantica and is a major tourist draw for the habitat. His songs have an unequaled emotional resonance. For those who are lucky enough to experience his music in a neo-cetacean or sonar-capable morph, his songs actually form three-dimensional sonic constructs. Not to be missed.

Li Cao: This neo-octopus's watercolor portraits hang in every major gallery in the solar system, including, remarkably, the Jovian National Center. The biocons are willing to overlook Li's uplift nature. She's *that* good. Media personalities always seem to focus on the fact that she uses all eight arms simultaneously, but this is little more than a stunt. What really separates her out from other artists is her ability to capture a subject's emotion and her innovative use of color.

Delio Cortez: Celebrated for his oils, this neo-orang painter of landscapes is not only an artist, but a gatecrasher as well. He will typically join a mission to a new world and stay behind to paint a score of canvases. Then it's off to the next exoplanet. Cortez's paintings bring alien landscapes to life. Gatecrashers say his work is just like being there.

Andromeda: This gray parrot is noted for his holo-sculpted abstracts, a three-dimensional swoop of light and color and a rush of sound that is computer projected in a darkened theater. Andromeda is currently on a celebrated tour of the outer system with his show: *Speed.*

working with an uplift corp like Somatek. And frankly, there are a lot of uplifts who have good reasons to be really, really angry. Working security gives them an excellent opportunity to knock some heads together. Even better that those heads are usually human. High-risk work usually means high pay too, so security can be a fast track to paying off an indenture and being able to do your own thing all the sooner.

Full uplifts are the high end of the animal security spectrum, but they aren't the whole shebang. Smart animals are routinely used by police and security forces across the system, particularly canines and baboons, but others as well.

GATECRASHING

TerraGenesis, Pathfinder, and Gatekeeper like uplifts for the same reason that the security firms do: special talents. Aerial recon, ocean exploration, micrograv versatility—uplifts bring many useful abilities to the extrasolar table. On top of that, their non-human mindsets could potentially be an aid when dealing with alien artifacts or a first contact scenario.

A proportionally high number of uplifts apply for gate lotteries or seek out other gatecrashing opportunities. There are many reasons for this. Some uplifts are simply looking to escape the confines of human society, trying to find a new life on the frontier. Some are hoping to prove themselves. Others are drawn to a situation where they and humans are on equal footing—out of their element, surviving on their own capabilities, and potentially dealing with artifacts or creatures unlike anything we've seen before. Many uplifts, particularly the neo-hominids, are driven by the same monkey curiosity that motivates humans.

More than a few uplift groups have sought and even established their own extrasolar colonies. They see it as a perfect opportunity to pursue a future for their species outside of human interference.

MEDIA AND ENTERTAINMENT

Uplifts have shown repeatedly that we are just as artistically inclined as humans. Many uplifts, particularly neo-cetaceans, neo-orangutans, and neo-neanderthals, have exhibited incredible musical abilities. Others have excelled at acting, reporting, sculpture, game design, writing, dance, digital media, and numerous other arts. In fact, uplifts have introduced humans to a number of artistic forms previously unknown to them such as acoustic sculpture and aerial dance.

Uplift penetration of the spheres of cultural production is still a mixed affair. Many uplifts appear in human vid/mesh/X dramas, but they are rarely the lead role. Uplifts are often cast as non-threatening sidekicks to human stars, as terrorists or criminals, or even baseline creatures. Even roles meant for uplifts are usually not written by uplifts, so we're usually reduced to the same dumb stereotypes. Bonobos are sluts, gorillas are brutish thugs, ravens are thieves, octopi are evil plotters, and dolphins are immature. Many of my people find this kind of programming to be exploitive (especially mercurials). The justification given by uplift actors—that they are just taking the work they can get—does little to salve the anger and humiliation caused by these programs. Likewise, where many uplifts succeed as performers, journalists, musicians, artists, etc., they rarely achieve the status of their human peers.

There is an entire subset of media programming that is specifically tailored to uplift sensibilities. This programming is very different than standard human fare. Not only are there the obvious political and cultural differences reflected in news and opinion pieces, but the *entertainment* itself is different. A romantic comedy designed for bonobos needs to take into account their matriarchal social structure and one for dolphins needs to be shaped by our inability to keep secrets. XP recorded for uplifts is also quite different, as we focus on different senses than humans.

CRIME

It is common in transhuman culture for members of disenfranchised, low-status groups to turn to crime. Or to put it another way: "If the law has no respect for me, why should I respect the law?" So it shouldn't be shocking that many uplifts have turned to a life of crime—a proportionally larger percentage than in the broader transhuman culture as a whole.

Many of these law-breakers are not at all criminal-minded. Any uplift who manages to escape a hypercorp before their contract is fulfilled or tries to hack their own reproductive system or shares their medical history with an unapproved doctor is a criminal—at least according to many inner system jurisdictions. And there is a whole network of people, including many free uplifts, who work to get runaway uplifts out of the inner system. Again, this behavior is illegal, and certainly dangerous, but it's hard to really call it criminal.

There are, however, plenty of real uplift criminals. Those who just want to make a buck (like yours truly) often become smugglers. It's high profit, and since it's only an economic crime, it's *relatively* safe. If you're caught, you usually only have to pay a fine—or a bribe. Another good thing about the trade in illegal goods is that it gives you the opportunity to smuggle *out* runaway uplifts.

Among the larger, more established criminal cartels, uplifts have only a small presence. Many of these syndicates are conservative-minded and frankly prejudiced towards synthmorphs. Others see us primarily as a commodity in which to trade. Nevertheless, many recruit uplifts as security, pit fighters, prostitutes, couriers, mules, and so on. Uplifts have a larger presence among smaller, more localized groups.

A few uplift-specific gangs and outfits have formed. While most are small, the most notable is the Hidden Concern, a cartel run entirely by uplifted octopi, which holds sway in the sub-crustal Hidden Sea of Ceres and maintains a stranglehold on water extraction operations. Cerean octopode morphs are specially adapted to survive in the ammonia-rich waters of the Hidden Sea. The Hidden Concern can best be described as a collection of robber-barons growing rich from their control of a key natural resource. All those who live in the belt know it's dangerous to cross them, as their response is likely to be an unsettling combination of ruthless and playful. It's said by some that the cartel employs a modified giant squid living in the depths of the Hidden Sea to dispose of its enemies. Whether this is the truth, or just an exceptionally terrifying lie, no one knows.

BIOLOGY IS NOT DESTINY

One of the fundamental benefits of transhuman culture is that you're not stuck in any one body. You can switch bodies if you like—or if you're a bit more cautious, your fork can try something new and then reintegrate, giving you a totally new experience with very little risk. Which all has fascinating implications for uplift. Talk about walking a mile in another species' shoes.

Scientists engaged in uplift research often upload themselves into an appropriate morph to gain some insight into the species they are enhancing. The same is also true of diplomats and trade representatives negotiating with uplift groups and those humans who believe in experiencing the great diversity of morphological possibilities.

There is a big market for humans seeking an uplift experience. Some are hoping to sleeve a neo-hominid or neo-neanderthal and get a taste of what it was like being a primitive human. Others want to literally fly like a bird or swim like a porpoise. Those with more taboo desires pursue any number of carnal delights. Not all humans who upload into an uplift morph do it for a transcendent experience—or even just for a quick thrill. For some transhumans it's nothing more than a day's work. Just about any advantage that an uplift has can be exploited by a Homo sap in the right morph.

Sleeving an uplift morph is not always so easy for humans, particularly the neo-cetacean and non-mammal morphs. Not every human finds it easy to adapt to fins, wings, or a beak and four extra limbs. Their mental architecture may simply not mesh well with the body, so they may find their hormones, urges, and emotions to be off-kilter and unsettling. In fact, many humans find sleeving into uplift morphs to be particularly distasteful. It squicks them out. Others love it so much, they never go back.

Humans who adopt an uplift sleeve soon find that there are repercussions, of course. They quite often encounter the same prejudice and discrimination that uplifts deal with on a daily basis. Many humans don't care if the ego behind the snout was born human, they find the *concept* of uplifts to be unnatural, or creepy, or weird. Others won't be overtly discriminatory, but they may subconsciously harbor a concern that a human in an uplift morph will be somehow affected by the experience and made more animalistic. There is in fact some truth to humans in uplift sleeves taking the opportunity to "go wild" and embracing their feral natures. Groups of human hooligans that sleeved up to "go ape" and cause a disturbance have hit the news more than once.

In the same vein, uplifts are often contemptuous of humans who decide to go joy-riding in an uplift morph. While some humans are honestly looking to learn, experience something new, or expand their knowledge, many have less than honorable motivations. Even those with good intentions are not expected to fully grok the uplift experience, though, that being something only a lifetime of living as a second-class citizen can convey. Some uplift radicals go so far as to side with human biocons who think that each species should stick to their own kind.

Though uplifts often try to stick with morphs from their own species, these are rare and hard to come by.

Uplifts commonly make use of human morphs as an alternative (as well as synthetic and pod options), though more than a few resent the fact that uplift interests are not more respected and so they are forced to play human. On the other hand, wearing a non-uplift sleeve can be a welcome respite from the daily chauvinism uplifts encounter, assuming they also hide their public profiles. Looking human gives them a chance to work in or travel through places they otherwise wouldn't be able to without repercussions, and it can be nice to punch through the glass ceiling that stands in their way. Some grow to prefer it. Bioconservatives and those with anti-uplift prejudices react poorly to uplifts in human sleeves, however, and hate crimes against them are not uncommon in the inner system.

For neo-cetaceans, choosing a non-uplift morph is a simple matter of practicality. The solar system just isn't built for us. It used to be. There used to be a beautiful blue jewel in the heavens. Not any more. Outside of Ceres, Atlantica, Europa, and the solar corona, there are few places for a neo-cetacean to be themselves.

This is slowly starting to change, but only slowly. Viable biological uplift morphs are just too rare and expensive to really mass produce, and the market for cheaper pods and shells is mostly humanoid, so unless you're a neo-hominid you're often stuck with something less than ideal when resleeving.

Fortean, the exomoon where they're trying to recreate mythical species, has been vital in addressing this need. Already they've gained notoriety for the ripwing pod but their newest creations have raised the bar even further. The chickcharnie and vodyanoy were designed as utilitarian options for neo-avians and neo-cetaceans, respectively. Likewise, the engineers of Feral Robot and similar studios are designing shells like the takko for commercial use, sacrificing little of an octomorph's natural dexterity for greater durability and the other advantages of a fully synthetic body.

Uplift Factions

Humans tend to think of uplifts as a single monolithic group, but nothing could be further from the truth. In addition to the tremendous variety that suffuses every corner of transhuman civilization and the obvious differences between species, uplift culture is governed by a wide variety of philosophical and ethical viewpoints. Despite the fears of the xenophobes, there is no single "uplift agenda," and no matter how the hypercorp media spins it, not all uplifts are mercurials.

The Sapient Faction

The largest faction of uplifts is also the least visible as such. The silent majority are those who simply want uplifts to be everyday, average, normal citizens, just like the rest of transhumanity. Called the sapient faction by the few that push this position as an ideology, the mercurials and more radical elements refer to them as assimilationists and anthrophiles. The agenda of this faction, if it can be called that, is for uplifts to have equal rights and equal opportunities with other transhumans. As part of this equal recognition, sapients are opposed to special legal status, breeding restrictions, and any other forms of institutionalized discrimination. At its core, it is the basic civil rights movement for uplifts.

Sapients seek to foster uplift assimilation and equality by getting the hypercorps and government authority on their side.

They participate in the existing system, lobbying politicians, encouraging corporate sponsorships, organizing around equal rights legislation, and so on. They work to portray uplifts in the media as no different from other transhumans, and thus fitting right in with the rest of mainstream society and culture.

In order to make uplifts seem no different from humans, sapients sometimes tend to curb, ignore, or shut out the more radical and extreme uplift ideologies and groups. In particular, they seek to de-emphasize references to uplift sexuality and sexual practices, as this tends to be a major squick factor for those opposed to uplift rights. Instead, sapients emphasize uplift contributions and achievements in science, art, philosophy, and other areas.

Brian Ngavi and the Somatek Uplift Program

Brian Ngavi, a neo-chimpanzee and the executive vice president serving as the public voice of Somatek's Uplift Program, is considered a leading proponent of the sapient agenda. Ngavi acknowledges some of the abuses and mistakes in past hypercorp uplift programs, but encourages uplift participation in various ongoing hypercorp uplift projects as the best path for the future of the uplift species. The more uplifts who participate, he argues, the more these initiatives will reflect uplift interests and avoid the pitfalls of the past. Ngavi makes numerous public and media appearances throughout the solar system, arguing on behalf of uplift civil rights and interests. He is purportedly the driving force behind several Somatek and joint hypercorp initiatives to improve the quality of life for uplifts throughout the solar system, including grants for increased education, vocational training projects, and sponsoring candidates for gatecrashing missions. Notably, he has defended Somatek's position on uplift indentures, stating that "uplifts cannot reject the debt that they owe humanity." This stance has earned him major criticism from mercurial groups, who label Ngavi as the chief apologist for uplift exploitation.

Since the departure of Rael Duvalier, Ngavi is for all intents and purposes the public face of Somatek. He often appears side by side with Jumbles. How much influence he has on Somatek policy, however, remains unclear. By all accounts, Ngavi is a determined and steady master of corporate politics as well as a first-rank scientific intellect. If there is leverage to be had over the board, there's little doubt he will know how to exploit it.

The Sapient Union

The Sapient Union is one of the largest uplift civil rights advocacy groups. Decidedly tame in comparison to the mercurials, the union does have a significant amount of activists and a wide base of popular and financial support. Many of their contributions and activist support in fact comes from humans who consider the union to be the most legitimate voice for uplift equality.

The Sapient Union goes beyond just supporting equal rights for uplifts—they hold the position that all life holds incredible value and deserves a place in the universe. This philosophy is tremendously appealing to many uplifts, particularly those with close ties to hypercorp and transhuman affairs. It is the only one of the principal uplift ideals that offers the realistic possibility of unification with transhumanity and beyond.

Linguist Lin Bao Chau, an uplifted gray parrot and one of the first neo-avian uplifts, is the lead figurehead of the Sapient Union. She initiated a controversy when she became the first uplift to adopt and raise human children.

Mercurials

First, a note about terminology. Some people use the term *mercurial* generically to mean any individual who is part of the non-human segment of transhumanity. This was in fact the first usage of the term. Since the Fall, however, mercurial has been adopted as a name for those uplifts (and also AGIs) who do not seek to conform to transhuman culture, mindsets, and standards.

Mercurial philosophy is defined by hostility toward the *human* in transhuman. It's not that mercurials hate humans (well, not most, anyway) so much as they resent human cultural imperialism. Instead, mercurials celebrate the uniqueness of uplifts and AGIs, oppose assimilation, and encourage the creation of non-human lifestyles, culture, and cognitive outlooks. They seek uplift and AGI *liberation,* not just equal rights.

It is a mistake to equate mercurial ideas with separatism or anti-human outlooks, though there are small numbers of supporters of both. Most mercurials are not opposed to being allied with transhumanity, they just want uplifts and AGIs to have control over their own future and to have the space to develop without human interference or co-optation.

Many mercurials link their attitudes towards uplift and AGI self-determination with other social justice issues and struggles. This argument is based on a criticism of the sapient movement as being too single issue, too focused only on civil rights and symptoms rather than the fundamental root causes. They relate the struggle for uplift independence from the hypercorps to the ongoing fights over infugees and indentured servitude. They connect uplift and AGI reproduction to the intellectual property battles between proprietary and open source models. They critique hypercapitalism for its exploitive ways and condemn government for injustice and inaction. You won't find many mercurial activists willing to accept corporate sponsorship or leadership.

Uplift mercurials also have a tendency to promote the very aspects of uplift nature and culture that their opponents condemn. They celebrate the various sexual tendencies of different species and support pansexuality between species of uplifts and humans.

Mercurial bonobos, for example, advocate sex as a universal conflict resolution tool, regardless of species. They highlight their nonhuman aspects and their adaptability to certain conditions and environments. They fully support uplifts who seek to modify themselves away from anthropocentric mental structures as well as researchers and programs that pursue alternatives to human socialization. Several mercurial research groups are reviewing the thousands of design decisions made by uplift engineers and asking themselves what choices might have been made if the choosers weren't human, but uplifts themselves?

The attractiveness of the mercurial philosophy varies greatly across different species. The non-hominid species have a higher proportional representation, possibly because the neo-apes are most likely to find similarities and affinity with human ways. And while mercurial philosophy fits quite well with the autonomist ideologies of the outer system, it is worth noting that uplifts who cannot easily shed their ties to their hypercorp patrons cannot just embrace the mercurial movement without the likelihood of severe repercussions. Much of the mercurial support in the inner system is underground, behind the scenes, or focused in areas more favorable to their cause.

It is also important to note that the mercurials are an ideological movement and not a monolithic group. There are many groups that identify as mercurials, and many iconic and self-styled leaders, but these often share small political disagreements in the fine print of their EULAs. Uplift mercurial groups range from activist outfits like the Conspiracy (archaic terms for a group of ravens) and the Non-human People's Project to militants like the Sapient Liberation Front and various uplift-only habitat enclaves.

Ties Between Uplift and AGI Mercurials

The relationship between uplift and AGI mercurials is complex and sometimes tenuous. Many mercurial activists from both sides see the ties as positive, thinking that both elements are striving for the same root changes against the same societal substrate issues and that their movement is stronger by unifying its efforts. There is solid evidence to support this, as their united forces have succeeded in winning some social or political campaigns that might have failed if fought separately. By connecting the two sides, mercurials can also highlight the connections between their struggles and larger social issues. On the other hand, the links aren't seamless. Not all non-humans appreciate being lumped together, arguing that their needs are quite often divergent and that the alliance is sometimes counterproductive. Many uplift mercurials, for example, fear that by working with AGIs the uplift portion of the movement is tainted by association with fears of the TITANs and another Fall, even though it is highly unlikely that uplift minds could undergo such an intelligence explosion. They also point out that as AGIs were programmed from scratch, they have no baseline to build from in defining themselves as different and non-human, and that by their very nature no AGI can truly be free from human influence. On their end, AGI mercurials point out that AGIs are significantly more persecuted and subject to restrictions, and that many AGIs are subject to termination and deletion, whereas uplifts are at least protected by anti-cruelty laws. The majority of mercurials downplay these differences, however, seeing the value in uniting for common causes.

Sapient Liberation Front

The Sapient Liberation Front is the direct-action wing of the mercurial movement. Organized as a decentralized memetic front, anyone who agrees with the SLF's principles and takes action can lay claim to the name. Though the SLF is considered a terrorist group by most of the inner system authorities, they largely seek to inflict economic damage against property and avoid targeting individuals or killing, though there have been some noted exceptions with targets they knew were backed up. Various SLF splinter groups also exist. A group called Raised Claw, for example, has been known to bomb scientific storehouses, labs, and even universities, killing those involved in the animal trade.

Mother Octopus

The neo-octopi known as Mother Octopus goes by a name unpronounceable by other sapients, as it can only be expressed as a pattern of skin colors

JUNGLE GYM

One of the major turning points for the mercurial movement was the Jungle Gym riot. Jungle Gym was an uplift club, frequented primarily by neo-bonobos, in Valles-New Shanghai. The neighborhood was popular for other uplift clubs as well, but the area was frequently targeted for police sweeps and uplifts themselves were often the target of harassment. Shortly after the Fall, following a months-long campaign of police intimidation and harassment, tensions in the area were high. An unprovoked police raid on the Jungle Gym nightclub in AF 3 pushed many of the uplifts too far. A full-on three-day riot ensued, with uplifts and their allies fighting the police back and driving them out (the police being hampered by some of their smart baboons switching sides or refusing to fight). The situation was broadcast across the solar system, presenting a unique opportunity for uplifts to speak out, rise up, and address the social injustices they faced. The mercurial movement became a widespread phenomenon and hasn't slowed down since. ■

and textures that other beings with enhanced vision and capable of seeing polarized light can perceive. Nicknamed Mother Octopus by some of her detractors, she has claimed the title for dealing with non-octopi. A respected leader of the movement, she is outspoken in her desire that mercurials live and work alongside transhumanity, treating them as an alien but allied species. A resident of Atlantica, she is a prolific writer and speaker for the mercurial cause. Her lifelog and mesh feed, though often incomprehensible to non-octopi, is followed by tens of thousands, particularly because she has proven to be a sharp and unrelenting debater, publicly eviscerating multiple ideological opponents who have flailed before her unbending principles. One of her top positions is that humanity has shown itself incapable of guiding its own way towards a prosperous future, in light of the Fall and numerous ongoing x-risks, and so humans have no ethical authority to regulate the bodies, minds, and lives of other sapient beings. She holds that all uplifts (and AGIs) should absolutely *demand* the sovereignty to make these kinds of choices for themselves.

The Voice

Another prominent but far more radical and mysterious mercurial leader is known only as the Voice. Reputed to be on the run from its previous hypercorp jailers, the Voice travels only via darkcast and under assumed identities, moving from habitat to habitat and never staying in the same place two nights in a row. Though rumored to often sleeve as a neo-raven, some whisper that this is a deliberate choice to hide their original phenotype. Paranoid, sure, but if you're involved in radical politics, another word for paranoid is careful.

The Voice is a speaker and organizer for the more militant end of the mercurial movement—those willing to engage in direct action and sabotage to promote their cause. Neither separatist nor anti-human, the Voice argues that action must be taken to undermine the hypercorps and other authorities that continue to exploit uplifts and control their futures. An anonymous, decentralized network of mercurials supports this effort, with the Voice recruiting new members and helping existing cells operate and communicate clandestinely.

According to some charges, the Voice has provided many of these radical mercurials with essential information to carry out their objectives, whether they were assisting indentured uplifts in escaping, exposing unethical experiments to the mesh, inflicting an economic toll on continued uplift research, or stealing proprietary genetic data to leak to mercurial researchers. It is not known where the Voice gets their data, which seems to come from inside sources, but it is highly reliable.

Smaller Uplift Factions

Your average human in the habitat corridor thinks that all uplifts are mercurials, unaware of the size and philosophical differences of the sapient faction. Even worse, they are likely to have gleaned something about some smaller uplift faction, who are universally disproportionately portrayed in the media to a much higher degree than their size and influence rates, whom they then proceed to confuse and conflate with mercurial positions. You'd be amazed at how many humans believe that the mercurials (whom they believe to be all uplifts) hate humans or want to go back to being animals.

Naturalists

The smallest uplift faction is also, perhaps, the saddest. Naturalists are those who condemn the process of uplift entirely. They refute the right of transhumanity to raise uplifts without permission (even though such permission is impossible to grant) and believe that the proper path for any biological species is to steer its own evolution unhindered by the manipulations of others. To this end, naturalists seek to halt the machinery of uplift. Allying with neo-primitivists, they have been known to launch terror attacks on uplift facilities and researchers.

Many naturalists also wish to personally reverse their alterations and return to their baseline animal species, or at least as close to it as they can get. Some of them have taken this suicidal path, recruiting rogue genehackers to develop procedures to reverse many of the physiological and cognitive enhancements in their genetic code. Others have taken the quicker route, and submitted their alpha ego to neural pruning psychosurgery, effectively crippling their cognitive faculties. The main problem facing these reverted naturalists is where to go afterwards. Some are taken in by friends and supporters (often human neo-primitivists) who care for them in habitats with nature preserves. The small habitat known as Second Chance, in the Mars-Sol L4 point, is one particular refuge for these poor benighted creatures. Several others have

EX-HOMINIDS

According to the human who raised me, there's a bad apple in every bunch. Among the uplifts, the rotten core would be a charming set of meatheads known as the Ex-Hominids. According to these lunatics' stated goals, they seek nothing less than the extermination of humanity—all to clear the way for a new era of hominid hyper-evolution. I guess the rest of us non-hominid uplifts aren't invited to the party. While small, their impact has already been felt in several bombings and assaults against several inner system targets. ■

arranged to be deposited on an appropriate exoplanet, where they can run (or swim or fly) free, while others have contracted with scavengers or reclaimers to be taken and left behind on Earth.

Not all naturalists go this far, of course. Most are content to argue their positions and peacefully do what they can to stop the growth of uplift research. These often work flipper-in-hand with the reclaimer movement, hoping to see a day when the Earth can be taken back and its former animal populations can be reseeded to live, die, and evolve as nature intended.

PURISTS

Uplifts are no more immune to speciesism than transhumans. There are plenty of chimpanzees who believe the chimp is the pinnacle of evolution, parrots who look down at their non-avian brethren, and octopi who truly believe that eight is enough. Though their numbers are small, minute even, their dogma is dangerous and disturbing enough to take note of. These groups are a shameful reminder that hate knowns no bounds.

Purist groups range from small public movements to secretive cells. Many are more akin to criminal gangs than activists or politicos. Their ideology is often rooted in rage at the treatment of uplifts by human hands. Many of their recruits are ignorant, misguided uplifts who were politically radicalized by some experience or event, and in the course of looking for answers they found the simplistic solution of scapegoating their enemies for all of their problems. Even those who adhere to supremacist outlooks usually claim to be oppressed and victimized unfairly, held down by the injustices of humans. Some publish manifestos that strike out with blind rage at those who they feel are most to blame for these problems. Others take more direct courses of action, striking back at their enemies.

Examples of this ilk include **Rising Tide,** a group of neo-orca supremacists. Blaming the destruction of their home oceans on humans, these orcas also identify as apex predators, physically superior to almost all other biological sapients in the system. Another example is the neanderthal terrorist organization **Wrong Turn.** Members of Wrong Turn believe that all history changed for the worse when cro-magnons drove the original neanderthals into extinction. Their goal is to correct that "mistake" and prevent it from happening again by wiping out all humans and assuming their proper place in the vanguard of transhumanity.

THE REVERENT

The reverent are filled with an adoration for human beings that sometimes borders on worship. They regard *Homo sapiens* as humble gods, the most successful child to arise from the cradle of Earth. Without humans, no uplifts would exist, so in reverent eyes humans should be idolized, cherished, rewarded, and served. Reverents follow transhuman culture slavishly, copying human styles of fashion, political trends, entertainment, and cuisine. Sex with transhumans is *extremely* popular. They often choose to sleeve in transhuman morphs, feeling incredibly honored to do so, as they will tell anyone who listens. Being mistaken for a human is considered one of the highest forms of flattery. Though some humans welcome the reverents' point of view—particularly the hypercorp shills who benefit from the loyalty of their citizens—*most* humans are made queasy by their pseudo-worship.

The reverent are the only uplift faction that fully supports the genetic and reproductive controls forced upon uplifts. They reason that uplift is a tremendous gift—and only the best among the baseline creatures deserve it. Besides, if the very transhuman scientists who brought them into the world believe uplift should be limited to genetically perfect specimens, who are uplifts to argue with the wisdom of their betters?

Mercurials despise the reverents. They consider the reverents' subservience a shameful display of self-loathing and speciesism. Some mercurials have gone so far as to "out" reverents in human morphs, making it difficult for them to pass as human. Some have theorized that the reverents are a hypercorp experiment to breed willing uplift slaves—and in truth, a number of the reverents' core initial membership was composed of neo-chimpanzees bred by the same hypercorp (which one? I'll let you dig up that gem yourself). Amusingly, when faced with the inevitable Uncle Tom epithets thrown their way, the average reverent will smile serenely and say: "Uncle Tom? See? You even rely on humanity for your *insults*."

ALLIES AND ENEMIES

Uplift is a divisive topic among humans as well as non-humans, and many transhumans have taken sides.

BIOCONSERVATIVES

Very few uplifts choose to live among bioconservatives for obvious reasons. Biocons almost uniformly look upon uplifts as freaks, creatures that don't belong. Which doesn't mean that the Jovian Junta is above experimenting on military applications for smart animals (and if you believe the rumors, war apes and worse); human ethics can be remarkably flexible. In general, uplifts and biocons are like oil and water. Most biocon colonies ban uplift research as well as uplifts themselves. In other habitats, various bioconservative groups continue to lobby against uplift research and other genetic and cognitive "abominations" and to do what they can to restrict uplift rights.

BROKEN SHACKLES

Broken Shackles is a decentralized network of anarchists and like-minded individuals that support the cause of uplift liberation. The group has no official leadership, no budget, and no membership lists, but

it does have a number of skilled hackers and darknet resources at its disposal. The primary goal of the group is to collect and organize data that may be of interest to mercurials, other radicals, and uplifts simply seeking to break free from indentured service. Much of their data-scraping is used to illuminate the operations of some of the more oppressive uplift hypercorps, sometimes leaking this data to the public mesh via MeshLeaks. They also investigate and attempt to crack the codes on genetic service packs and similar proprietary genetic locks, seeding this data to the mesh so that others can use it to pirate genomes for uplift reproduction or bypass built-in morph obsolescence. A database maintained by Broken Shackles provides up-to-date data on uplift legalities in different jurisdictions, an essential resource for uplifts looking to avoid legal entanglements. The database also monitors and tracks the activities of ego hunters known to pursue uplift runaways. The group also provides fake IDs and travel options for uplifts looking to go underground.

Broken Shackles data hubs and supporters have been targeted multiple times by hypercorp counter-intelligence units. An ongoing low-intensity conflict rages between these parties on the mesh, sometimes spilling over into the real world.

Neo-Primitivists

The primmies have a nuanced response. They despise the premise of uplift, condemning it as a continuation of humanity's hubris and the ongoing system of oppression and destruction of nature brought about by civilization itself. Hypercorps that research or engage in uplift are nothing more than torture mills, Frankenstein labs, and death camps in their eyes. On the other hand, they do not despise uplifts (except those that continue to engage in and support uplift research), but consider them victims of progress and technological society. Neo-prims support attacks on uplift hypercorps (as well as autonomist syndicates and uplift groups that pursue uplift tech) and the liberation of test subjects from labs. Groups like **Zerzan's Brood** and **Deep Green Strike** have bombed uplift research facilities, setting some promising projects back by years. As mentioned previously, some neo-prims work with uplift naturalists, helping them to "revert" back to animalistic states.

Chmod 700

This small and secretive mercurial group was founded by AGIs. The intent of the group is to take permission to modify the minds of AGIs (and also uplifts) away from humans and place it in the hands of AGIs (or uplifts, respectively). Unusually, Chmod 700 actually supports bans on AGI creation/programming—for humans, at least. Since the concept of allowing AGIs to self-propagate and upgrade themselves does not go over so well with most transhumans in the wake of the Fall, Chmod 700 encourages AGIs interested in either to relocate to hidden brinker stations on the edges of the solar system or tucked away on exoplanets. In the same vein, however, Chmod 700 also supports uplift control over uplift reproduction and modification, which is seen as a more feasible near-term goal. This has led to Chmod 700 similarly establishing remote outposts for uplifts to experiment in upgrading and propagating their species.

A major component of Chmod 700's uplift projects is investigating distinctly non-human mental architectures and cognitive modes. Researchers with the group have allegedly made several breakthroughs in this area, though to what degree is unclear. Just recently a secret NWA lab was destroyed by an unknown group hostile to their interests.

Rael Duvalier and the SIBA

Rael Duvalier may be the worst kind of enemy—the one who believes they're acting in your best interests. The former CEO of Somatek, Duvalier was ousted from the board when Somatek took a more liberal turn. As the lead scientist behind the first uplift, Jumbles, Duvalier had pioneered and defined Somatek's uplift agenda, eagerly copied by other hypercorps, and set the groundwork for the ideology that uplifts needed to be shepherded into sapient adulthood by a wiser patron: humans. According to Duvalier's philosophy, uplifts are property, not people, and owe a debt to those who raised them up, until their wise patrons deem them fit and mature enough to thrive without supervision. Though Duvalier no longer has influence at Somatek (except with some old-guard figures that escaped the purge), he is exceedingly wealthy and remains active in uplift affairs. He sponsors numerous anti-mercurial projects, including the Uplift Patron Foundation, has his claws in a number of ongoing hypercorps, and uses his influence to sway legal decisions and public policy regarding uplifts (and other matters) in the inner system. He owns an entire exoplanet, Tirion, accessed via the Martian Gate, home to the Singer Institute for Biological Anomalies—his private uplift-related research program.

Religious Groups

Religious fundamentalists generally don't like uplifts either. Their reticence often turns on the question of whether uplifts can have a soul. Clearly baseline creatures cannot. (After all, God gave man (sic) dominion over the creatures of the Earth.) So if animals don't have souls and uplifts do, they would have to be granted souls by godless scientists. Obviously this presents something of a theological conundrum. Plus, I think many zealots are unnerved by the prospect of arguing about evolution and creation with an uplifted ape.

The religious organization **Lord's Dominion** can only be described as a hate group, a collection of biocon religious fanatics who see it as their mission

to bring Earth's creatures back under God's or Allah's or whomever's dominion. It is a small group, to be sure, but there is strong evidence that elements of the Jovian Junta are funneling funds and resources to the group. The Dominion's principal area of operation is Jupiter and the asteroid belt. A series of gut-wrenching crimes has been tied to them. Uplifts traveling in an area where the Dominion has struck before should be wary. Their boldness seems to be growing.

On the other hand, there are religions that embrace uplifts. Some hindus and techno-creationists regard uplifted creatures as fellow travelers on the path to universal wisdom and believe that path cannot be traversed without them. Neo-buddhists note that uplift technology raises the consciousness of the creatures it touches and thus increases the overall sum of universal happiness.

The Uplift Patron Foundation

This think tank and lobbying group has one major agenda: ensuring that uplifts remain in the control of humans. They create policy documents, draft legislation, and file and join lawsuits aimed at keeping uplifts as second-class citizens. Following Duvalier's ideology that uplifts require the guiding hand of humanity and that they owe humans for the favor, they work strongly to counter uplift civil rights and defend reproductive controls and indenture programs. The foundation also organizes and trains anti-mercurial activists to counter the spread of mercurial and other radical uplift agendas. The mercurials call out the UPF as a speciesist group hiding under the mask of legitimacy, and point out that a number of individuals connected to violent attacks against uplifts have been linked to or even openly affiliated with the UPF.

Notable Habitats

Uplifts are found throughout the solar system, many living among transhumans just like everybody else. Some choose to live exclusively with their own kind—which might mean their own species or their own uplift faction. Others choose an even more exotic lifestyle. Some of the primary habitats of interest to uplifts are detailed below.

Atlantica

Atlantica is a tiny Cole bubble located in the main asteroid belt. It's like any other bubbleworld, with one key exception—the water used to form the cylindrical shape of the habitat was never drained. Instead it was filtered and augmented with certain sodium and magnesium salts. The habitat rotates along its axis, imparting a centripetal acceleration that mimics gravity. Ocean dwellers have no particular use for gravity, but the angular momentum slings the water to the habitat's walls, leaving a cylinder of air along

the habitat's axis. The mirror arrays that provide the habitat with its light are carefully arranged to reproduce Earth-like patterns of day and night. When the sun shines, the water in the entire habitat is a crystalline blue. During darkness, an augmented reality version of Earth's night sky is projected on the water's surface along the center axis ("up," given the spin gravity).

Atlantica is a little slice of ocean a kilometer in diameter and three in length, home to 3,000 aquatic uplifts as well as numerous transhumans who yearn for the oceans of Earth. As might be expected, Atlantica is home to neo-cetaceans and neo-octopi—including the last of the true whales. Politically, Atlantica is a non-aligned habitat based on free-market libertarian models along the lines of Extropia. The habitat is largely self-sufficient, but there are many things its inhabitants want from the outside world.

Atlantica has amassed one of the best aquatic genetic archives and collection of sea life from Earth, hosting the largest living populations of coral reefs, sea turtles, tropical fish, and plankton in the solar system. Some whisper that the Atlanticans have been involved with smuggling sea creatures from Earth. The Atlanticans deny the charges, saying they have resurrected some species from DNA, and maintaining that the convict tangs, Picasso triggerfish, and other dazzling organisms came from the genetic stocks of marine biologists and private collectors. The habitat's principal business is ecotourism, drawing people from around the solar system to experience an artificial ocean environment and charging astronomical fees for the opportunity to sleeve as a neo-cetacean or neo-octopus. Some mercurials consider this a sell-out, but the Atlanticans argue that they are building a constituency within transhumanity that is sympathetic to uplift interests and needs.

Atlantica owes its existence to the wealth and support of the famous neo-whale, Deep Current Black Killer of Squid, as well as several other unknown private investors. Given the great success with Atlantica, these parties are already planning their next ambitious project: *Pacifica*. Ten cubic kilometers may seem like a lot of space, but only half of that is water, and neo-cetaceans require a *lot* of volume. In some ways, Atlantica is a proof of concept. The next habitat will be a much larger environment for Earth's refugee sea life to call home.

PACIFICA PROJECT ACQUISITIONS LIST

I got the following passed along to me by a "friend" at Atlantica who thought we might be the people to talk to about getting ahold of some rare biological specimens. This is the kind of friend who has very deep pockets and is offering excellent compensation for these samples.

She seemed to believe we might have some secret means of actually getting back to Earth but I took pains to assure her that she was mistaken and that myself and the reclaimers of Vo Nguyen work for the safe and legal return to our homeworld. Still, I can see her point, some of these species likely were never taken offworld and, if they exist at all, it's in the oceans of our lost home.

Pang, if you find any collectors or dealers of the following in your travels please let them know I am most interested in striking a deal with them to procure their specimens. Of particular interest to myself and my fellows are:

- *Lysiosquillina maculata,* the zebra mantis shrimp, which once was found in the Indo-Pacific region.
- *Antennarius striatus,* the striated frogfish from Indonesia and Malaysia.
- *Vampyroteuthis infernalis,* the vampire squid that formerly inhabited tropical and subtropical deep waters.
- *Chondrocladia lampadiglobus,* the ping-pong tree sponge, one of the rare species that called the Marianas Trench home.

MAHOGANY

Mahogany was the first of the avian habitats. Deliberately positioned deep in the out-system, orbiting Neptune, Mahogany is an important mercurial habitat far from the influence of the inner-system hypercorps. An unusual disc habitat design, Mahogany has a population of 4,000 uplifts, most of them neo-avians. A member of the Autonomist Alliance, this station has signed mutual defense agreements with nearby autonomist colonies.

Mahogany is more than just an avian habitat. It's a symbol of what mercurial society might look like without the overbearing presence of man. Every aspect of the station's culture is studied and debated by mercurials from one end of the solar system to another, giving Mahogany, and the avians that inhabit it, an outsized role in building mercurial culture.

MIGRATORY VERMIN

The presence of uplifts among Scum swarms is hardly rare, but the swarm known as Migratory Vermin is another thing entirely. Nearly half of the two dozen collectives of the swarm are entirely or mostly uplifts. The largest collective, which also gives the swarm its name, is a flock of uplifted ravens.

Plying a route that ranges between Mars, Extropia, and the Martian Trojans, this swarm of small ships is always willing to take on new members and is especially helpful to uplifts who may be on the run from inner system authorities. Both the Consortium and the Lunar-Lagrange Alliance have lodged numerous complaints against Migratory Vermin over

their interference with bonded ego hunters looking for uplifts that have skipped out on their contracts. The scum simply smile and contend that they would never do anything of the sort, and suggest that the claims that any members of the swarm may or may not resemble wanted fugitives is due to the inability of narrow-minded ego hunters and hypercorp administrators to tell one uplift from another.

Migratory Vermin is also an excellent place to score drugs that have been specially designed for uplift anatomies. If an uplift can get high on it, or otherwise get some sort of kick from it, someone on the swarm likely has access to it.

TREEHOUSE

Treehouse is an O'Neill cylinder stationed in the Mars-Sol L5 point that is home to 37,000 souls. Originally established by a conglomerate of hypercorps, each pursuing their own research projects and manufacturing ventures, over time a number of small uplift-oriented hypercorps found their way here, taking advantage of their proximity to collaborate and share resources. With many of these corporations holding a more enlightened attitude towards uplifts, the local population of free, non-indentured uplifts began to grow. The local corporate government passed legislation to make the habitat even more attractive to uplift residents, encouraging uplifts to relocate here. In the years since, Treehouse has developed one of the largest uplift populations in the solar system (35% of its residents), intermixed with the rest of its transhuman population. Treehouse has become a focal point for the Sapient Union and similar pro-uplift (but non-mercurial) factions. Tolerance and equality are embraced here. The people of Treehouse hope that one day their ideals will be the model for the rest of the solar system.

VALLEY OF THE APES

Valley of the Apes is a subdivision of the Martian community of Red Jakarta, tucked into a rarely trafficked spur of Valles Marineris. Home to forty thousand, most of the habitat is enclosed under two small domes. Behind them, a transparent enclosure covers a good twenty klicks of the branch valley's winding path. Inside this habitat is a lush tropical forest, occupied by a small population of uplifted apes with a sense of humor and a love for old movies (one of the local artists actually constructed a half-buried Statue of Liberty, which they proudly planted right out front). The valley walls climb ten meters above the floor, and the space between them is filled with bowers set among tree branches and little caves carved out of the rock walls. In the light Martian gravity it's easy for the apes to climb—even gorillas.

The Valley and the rest of Red Jakarta work hard to maintain independence. The settlement is not a member of the Tharsis League, though it does much of its trade with League habitats as well as hypercorps. This doesn't prevent the locals from maintaining good relations with the Barsoomians. The apes are always willing to quietly sell hypercorp goods to their backcountry neighbors in the interest of mutual aid—and profit.

UPLIFT DIASPORAS

In addition to the above-named habitats that tend to have a majority uplift presence, there are several transhuman habitats that maintain a sizable uplift population despite not being governed by, or in a few cases even sympathetic to, uplifts.

The bright lights and big promises of the entertainment industry in **Elysium,** on Mars, serves as a major draw for a lot of younger uplifts who have recently paid off their indenture and have dreams of making it big. Unfortunately, the number of parts available for talented young things is not commensurate with the number of hopefuls and a lot of them end up having to abandon their dreams. The smart ones recognize this before they run completely out of credits, but there are plenty who hang on too long and end up having to sign another indenture contract to get their asses out of debt.

Naturally **Extropia** attracts a large number of uplifts. Hell, Extropia attracts a large number of just about anything. The boom-town feel and easy-come, easy-go attitude that reigns over the place is often a refreshing change for uplifts from the inner system who are used to being judged not on what they can bring to any given business proposition, but rather on their appearance or ancestry. In Extropia, most people could care less who you are or where you came from as long as you can back up whatever you happen to be selling. But for these reasons it also tends to be avoided by uplifts. A lot of us want to believe that we're special, that there's something more to us than other transhumans, and Extropia is not the kind of place that goes out of its way to make you feel welcome.

A place like **Locus** is appealing to all sorts of freedom-minded folk, and uplifts are no exception. Within its array of linked modules there are concentrations of every known type of uplift. The microgravity environment means that neo-avians and neo-octopi are especially at home on Locus. Both thrive by using their natural abilities to garner gains in reputation.

While the oceans of **Europa** are nothing like our lost home, the call of any sort of body of water you can get lost in has a certain appeal to some of my fellows. While the Europan seas are hardly similar to those of Earth, they still represent our best bet for happiness. Though some neo-cetaceans prefer to sleeve in a surya and swim around the sun, many of us prefer that feeling of crushing pressure and lightless depths. Plus our natural abilities to navigate such surroundings makes us a hot commodity on Europa.

HABITAT RULES

Hacking the Infrastructure: From airlocks to reactors. ■ **p. 164**
Infiltration: How to maneuver without detection. ■ **p. 168**
Mesh Systems: Topology and access. ■ **p. 169**
Habitat Morphs: Becoming a space station. ■ **p. 172**

SURVEILLANCE RULES

ID: Brainprints and nanotats ■ **p. 158**
Sensors: Different forms, how to detect, and how to use ■ **p. 159**
Comprehensive Sensor Chart: For easy reference. ■ **p. 161**
Surveillance: Getting caught on tape. ■ **p. 162**
Countersurveillance: Not getting caught on tape. ■ **p. 163**

GAME INFORMATION

UPLIFT RULES

Uplift Gear and **Drugs:** Not being human can make a difference. ■ **p. 174**
Smart Animals: New species, training and biodrones. ■ **pp. 154** and **p. 175**

NEW GEAR

New Morphs: New uplift morphs and bodies designed for (counter)surveillance. ■ **p. 144**
New Enhancements: Bioware, cyberware, and robotic mods. ■ **p. 150**
Countersurveillance Gear: For avoiding watchful eyes. ■ **p. 152**
Sensor Systems: For the voyeur in all of us. ■ **p. 154**
Robots and Vehicles: Bughunters, flux cars, and more ■ **pp. 157–158**

5

This chapter provides rules for handling uplifts, habitats, and surveillance systems, as well as new morphs, new gear, and plot hooks that tie into material covered in the previous chapters.

NEW MORPHS

At the gamemaster's discretion, these may be allowed during character creation.

CHICKCHARNIE (POD BIOMORPH)

Another creation by the mad geniuses of the exoplanet Fortean (p. 94, *Gatecrashing*), this morph is a modified version of a resurrected species. The extinct *Tyto Pollens* was a large pre-Columbian flightless ground owl species in the Caribbean. The *chickcharnie* was rumored to be a supernatural variant of this bird that haunted the forests bestowing boons or curses upon travelers depending on how they treated it. The Fortean version of the chickcharnie is best described as a humanoid owl. Over one meter in height, it is bipedal but stands shorter than humans. Though winged, it is flightless except in very low grav environments and microgravity. Its wing design, however, incorporates a functional set of clawed hands. The chickcharnie is growing in popularity among neo-avians who don't mind sacrificing flight for physical resilience, more functional hands, and a stature closely approximating transhuman standards.

Implants: Basic Biomods, Basic Mesh Inserts, Cortical Stack, Cyberbrain, Mnemonic Augmentation, Prehensile Feet, Puppet Sock
Aptitude Maximum: 25
Durability: 35
Wound Threshold: 7
Advantages: Beak/Claw Attack (1d10 DV, use Unarmed Combat skill), +5 COO, +5 INT, +10 REF
CP Cost: 35
Credit Cost: Expensive

GARGOYLE (SYNTHMORPH)

Gargoyles are an anthroform synthetic morph designed as a mobile sensor unit. They are used by media, freelance journalists, forensics teams, and anyone who is regularly required to document a situation thoroughly. Though humanoid in shape, gargoyles stand taller than average transhumans for better viewing. Much of their exterior surface is covered in quantum dot camera-displays.

Enhancements: 360-Degree Vision, Access Jacks, Anti-Glare, Basic Mesh Inserts, Chemical Sniffer, Cortical Stack, Cyberbrain, Enhanced Hearing, Enhanced Smell, Enhanced Vision, Lidar, Mnemonic Augmentation, Nanoscopic Vision, Oracles, Radar, T-Ray Emitter
Mobility System: Walker (4/20)
Aptitude Maximum: 30
Durability: 40
Wound Threshold: 8
Advantages: +5 INT, +5 to one aptitude of the player's choice, Armor 6/6
CP Cost: 40
Credit Cost: Expensive

HYPERGIBBON (POD BIOMORPH)

Built from siamang genestock, the largest of the lesser apes, hypergibbons are often mistaken for uplifts, although this is not the case. The gibbon was never a candidate for uplift due to a brain anatomy considerably more primitive than great apes. With the addition of a cyberbrain, though, they make excellent pods. Many primate uplifts choose hypergibbons in place of other pods or when they need something small like a neotenic.

Hypergibbons stand about 1 meter tall, weigh 15 kilograms, and typically have black fur and skin (although bodysculpting permits many variations). They have inflatable throat sacks that allow melodious calls that carry great distances. Their wrists feature a ball-and-socket joint and also naturally dislocate to enable easier swinging by the arms.

Implants: Basic Biomods, Basic Mesh Inserts, Cortical Stack, Cyberbrain, Mnemonic Augmentation, Prehensile Feet, Puppet Sock
Aptitude Maximum: 30
Durability: 25
Wound Threshold: 5
Advantages: +5 INT, +5 REF, +10 Climbing skill, +20 Freerunning skill, Limber (Level 2) trait, hypergibbons count as a small target in combat (–10 to hit)
Disadvantages: Social Stigma (Pod)
CP Cost: 30
Credit Cost: Expensive

NEO-BELUGA (BIOMORPH)

Neo-belugas are the smallest and most numerous of the surviving whale uplifts, ranging 5.5 meters in length on average. They are white-skinned with no dorsal ridge, toothed, and have the distinction of being the only whale that can swim backwards.

Implants: Basic Biomods, Basic Mesh Inserts, Cortical Stack, Echolocation, Enhanced Hearing, Oxygen Reserve
Movement Rate: Swim (16/40)
Aptitude Maximum: 25
Durability: 35
Wound Threshold: 7
Advantages: +5 COO, +5 INT, +5 SOM, +5 to one other aptitude of the player's choice, +40 Swimming skill, Ramming Attack (1d10 DV)

Disadvantages: Neo-belugas lack a sense of smell and count as a large target in combat (+10 to hit)
CP Cost: 45
Credit Cost: Expensive (minimum 40,000)

NEO-DOLPHIN (BIOMORPH)

The uplifted versions of various dolphin species are very similar to baseline dolphins physiologically. Thanks to the oxygen reserve implant, neo-dolphins can stay underwater for longer (Cerean dolphins have gills installed, as the subcrustal sea has no breathable atmosphere above it). Common neo-dolphin germlines lack hands or other limbs, though cybernetic arms or even bioware enhancements are not uncommon. Neo-dolphin morphs are very rare, since there are few habitats that can support them, and they are almost never found apart from aquatic environments.
Implants: Basic Biomods, Basic Mesh Inserts, Cortical Stack, Echolocation, Enhanced Hearing, Oxygen Reserve
Movement Rate: Swim (16/48)
Aptitude Maximum: 25
Durability: 30
Wound Threshold: 6
Advantages: +5 COO, +5 INT, +5 SOM, +5 to one other aptitude of the player's choice, +40 Swimming skill, Ramming Attack (1d10 DV, use Unarmed Combat skill)
Disadvantages: Neo-dolphins lack a sense of smell.
CP Cost: 40
Credit Cost: Expensive (minimum 35,000)

NEO-HOMINID (GORILLAS) (BIOMORPH)

To highlight the differences in neo-hominid species, apply the following stats for neo-gorillas. The neo-hominid entry in the *Eclipse Phase* core rulebook applies for neo-chimpanzees, neo-bonobos, and neo-orangutans.
Implants: Basic Biomods, Basic Mesh Inserts, Cortical Stack, Prehensile Feet
Aptitude Maximum: 30
Durability: 40
Wound Threshold: 8
Advantages: +5 INT, +10 SOM, +5 to one other aptitude of the player's choice
CP Cost: 35
Credit Cost: Expensive (minimum 30,000)

NEO-ORCA (BIOMORPH)

Though colloquially referred to as killer whales, orcas are actually members of the dolphin family. The average neo-orca length is 7 meters for males, 6 meters for females. Males also have larger and more triangular pectoral fins.
Implants: Basic Biomods, Basic Mesh Inserts, Cortical Stack, Echolocation, Enhanced Hearing, Oxygen Reserve
Movement Rate: Swim (16/60)
Aptitude Maximum: 30
Durability: 40
Wound Threshold: 8
Advantages: +5 COO, +5 INT, +10 SOM, +5 to one other aptitude of the player's choice, +40 Swimming skill, +20 Unarmed Combat skill, Bite Attack (2d10 DV, use Unarmed Combat skill)
Disadvantages: Neo-orcas lack a sense of smell and count as a large target in combat (+10 to hit)
CP Cost: 60
Credit Cost: Expensive (minimum 50,000)

NEO-PIG (BIOMORPH)

Uplifted pig morphs are bipedal and feature transgenic hands, feet, and vocal systems. They tend to be slightly shorter than the average transhuman but much stockier. Males grow tusks from their lower jaws
Implants: Basic Biomods, Basic Mesh Inserts, Cortical Stack
Aptitude Maximum: 25
Durability: 35
Wound Threshold: 7
Advantages: +5 SOM, +5 to one other aptitude of the player's choice
CP Cost: 20
Credit Cost: High

NEO-PORPOISE (BIOMORPH)

Neo-porpoises are smaller but very similar to neo-dolphins and similarly are much like their baseline relatives. They average 2.5 meters in length.
Implants: Basic Biomods, Basic Mesh Inserts, Cortical Stack, Echolocation, Enhanced Hearing, Oxygen Reserve
Movement Rate: Swim (16/56)
Aptitude Maximum: 25
Durability: 25
Wound Threshold: 5
Advantages: +5 INT, +5 SOM, +5 to one other aptitude of the player's choice, +50 Swimming skill, Ramming Attack (1d10 DV),
Disadvantages: Neo-porpoises lack a sense of smell.
CP Cost: 35
Credit Cost: Expensive (minimum 30,000)

NEO-WHALE (BIOMORPH)

Less than several hundred neo-whale morphs exist, and the majority remain occupied by their original egos. They are primarily found in Ceres and Atlantica. They are derived from humpback, blue, and sperm whale genetic stock. Humpbacks and blues are baleen whales and require large amounts of krill to survive. Sperm whales are toothed, feeding on fish and squid.
Implants: Basic Biomods, Basic Mesh Inserts, Cortical Stack, Echolocation, Enhanced Hearing, Oxygen Reserve
Movement Rate: Swim (16/40)
Aptitude Maximum: 30
Durability: 100

Wound Threshold: 20
Advantages: +5 COO, +5 INT, +5 SOM, +5 to one other aptitude of the player's choice, +40 Swimming skill, Ramming Attack (2d10 DV, use Unarmed Combat skill), Bite Attack (4d10 DV, sperm whales only, use Unarmed Combat skill)
Disadvantages: Neo-whales lack a sense of smell and count as a very large target in combat (+30 to hit)
CP Cost: 75
Credit Cost: Expensive (exceptionally rare; minimum 75,000)

SHAPER (POD BIOMORPH)

Shapers are the ultimate disguise morph. Constructed as pods, the default shaper look is intentionally generic, based on the computer-generated composite average look of the solar system's residents. They lack the distinctive seam lines applied to most pod morph designs. The skinflex system allows the morph to quickly change its outward appearance. Additional modifications help the morph evade or fool sensor and biometric systems. Shapers are a favorite tool for spies and are excellent for infiltration or fooling surveillance. They are often remotely operated via puppet sock. Shapers are illegal in many habitats.
Implants: Basic Biomods, Basic Mesh Inserts, Chameleon Skin, Clean Metabolism, Cortical Stack, Cyberbrain, Emotional Dampers, Gait Masking, Mnemonic Augmentation, Nanotat ID Flux, Puppet Sock, Sex Switch, Skinflex
Aptitude Maximum: 30
Durability: 30
Wound Threshold: 6
Advantages: +5 INT, +5 SAV, +5 to one aptitude of the player's choice
CP Cost: 45
Credit Cost: Expensive (minimum 40,000)

SKULKER (SYNTHMORPH)

Skulkers are a stealth swarmanoid designed to infiltrate sensitive areas and avoid detection by sensors.
Enhancements: Access Jacks, Basic Mesh Inserts, Chameleon Skin, Cortical Stack, Cyberbrain, Mnemonic Augmentation, Radar Invisibility, Swarm Composition
Mobility System: Walker (2/8), Hopper (4/20), Rotor (4/32)
Aptitude Maximum: 30
Durability: 30
Wound Threshold: 6
Advantages: See Swarm Composition (p. 311, *EP*)
Disadvantages: See Swarm Composition (p. 311, *EP*)
CP Cost: 35
Credit Cost: Expensive (minimum 30,000)

TAKKO (SYNTHMORPH)

The first synthetic octopus design from the engineers at Feral Robot is a hardy shell custom-designed to make octopi uplifts feel more at home in a synthetic body with eight functioning appendages. Though it lacks ink sacs, the takko features vectored-thrust jets for microgravity propulsion.
Enhancements: 360-Degree Vision, Access Jacks, Basic Mesh Inserts, Chameleon Skin, Cortical Stack, Cyberbrain, Enhanced Vision, Extra Limbs (8 Arms), Grip Pads, Mnemonic Augmentation, Polarization Vision
Mobility System: Walker (4/24), Thrust Vector (8/40)
Aptitude Maximum: 30
Durability: 40
Wound Threshold: 8
Advantages: Beak Attack (1d10 + 2 DV, use Unarmed Combat skill), +10 Free Fall skill, +10 Climbing skill,+5 COO, +5 INT, +5 SOM, Armor 8/8
CP Cost: 60
Credit Cost: Expensive (minimum 45,000+)

TAKKO SYNTHMORPH ■ ABOVE

NEW KNOWLEDGE SKILL

At the gamemaster's discretion, this Language skill variant may be allowed during character creation.

EXOTIC LANGUAGE

Type: Field, Knowledge
Linked Aptitude: INT

Intercepting a message only helps if the interceptor can understand it. Seamless translation software is available for most human languages, but there are many languages that died out before anyone bothered writing a translator. In addition to unusual spoken languages (e.g., extinct Native American languages), a number of rare sign languages existed among isolated populations who either had large numbers of deaf people (e.g., Martha's Vineyard, Al-Sayyid Bedouins) or taboos against speaking (e.g., the Australian Warlpiri, Trappist monks). These languages, or variations on them, are sometimes used by covert groups concerned about communication security. Linguistic isolates are favored, as these leave fewer clues for would-be translators.

The whistles, clicks, and ultrasonic burst-pulses of the neo-cetacean language also fall in this category, primarily because the ability to speak and perceive it is beyond the physiology of standard transhumans. Transhumans with enhanced hearing can hear neo-cetacean, and those with echolocation implants can "speak" it, albeit poorly. Neo-cetacean is adapted for underwater use and does not work at any significant range out of water.

Sample Fields: Neo-cetacean, !Kung, Al-Sayyid Bedouin Sign, Arogonese, Chong, Karon, Mayan Sign, Michif, Warlpiri Sign
Specializations: As appropriate to the field, representing dialects, technical jargon, and subcultural slang.

NEW TRAITS

The following traits may be available to starting characters at the gamemaster's discretion. Unless otherwise noted, these are ego traits.

POSITIVE TRAITS

HOME TURF

Cost: 10 CP

This character knows a particular habitat like the back of their hand, paw, or tentacle, having grown up there or spent years familiarizing themselves. They receive an extra point of Moxie that may only be used for tests that apply to that habitat, such as navigating the best route, bypassing airlock controls, or hacking its infrastructure.

INFORMATION CONTROL

Cost: 10 CP

This character has a knack for diligence and caution in their daily living, online, and social networking interactions, reducing the amount of extraneous or sensitive information about themselves that leaks out in the public eye. Apply a –10 modifier to any Research Tests to gather information on the character or track them online (see *Scanning, Tracking, and Monitoring*, p. 251, *EP*) and any Networking Tests to ascertain the character's networking interactions (see *Keeping It Quiet*, p. 288, *EP*).

SOCIAL BUTTERFLY

Cost: 15 CP

This character is a promiscuous abuser of online social networks. Because they go out of their way to make new connections and interact with people, they find it slightly easier to get what they need. Apply a +10 modifier to Networking Tests.

YOU'RE THAT GUY!

Cost: 10 CP

Sometime in the past, this character got their 5 minutes of mesh fame in a funny viral meme that swept the solar system. To this day, strangers who access the character's social profile are likely to connect them to that meme. Though tedious for the character, there is a positive side effect, as these strangers remember the meme fondly and are more likely to help the character out. Once per game session, the gamemaster may decide that a stranger with whom the character is interacting and who has access to the character's online public profile recognizes the character. The character receives a one-time +20 bonus to any social skill or Networking Test with that stranger.

NEGATIVE TRAITS

DATA FOOTPRINT

Bonus: 10 CP

The character is particularly sloppy about keeping a lid on their daily living, online, and social networking interactions, leaving a larger data footprint than usual in the public eye. Apply a +10 modifier to any Research Tests to gather information on the character or track them online (see *Scanning, Tracking, and Monitoring*, p. 251, *EP*) and any Networking Tests to ascertain the character's networking interactions (see *Keeping It Quiet*, p. 288, *EP*).

IMPAIRED BALANCE

Bonus: 10 CP (Level 1), 20 CP (Level 2), or 30 CP (Level 3)

This trait is only available to neo-pigs. This uplift's brain has not been fully adapted to the neo-pig's bipedal stance and still suffers occasional difficulties with balance. The character suffers a –10 modifier per level to any Climbing, Freerunning, or similar test involving balance or upright movement.

IMPAIRED HEARING (MORPH TRAIT)

Bonus: 5 CP

This trait is only available to octomorphs. This morph lacks the transgenic hearing modifications of modern octomorph designs. The morph can only hear

USEFUL HABITAT SKILLS

The following Knowledge field skills are useful when interacting with the systems aboard a habitat. While it's uncommon for Firewall agents to have deep familiarity with these skills, even a cursory knowledge can be helpful on cases where the workings of a habitat come into play.

Academics: Astrogeology: Used for asteroid prospecting. Typically this involves analyzing data collected by long-range sensors to determine the chemical composition and likely yield of a given asteroid or comet. For closer targets, transhuman prospecting crews or mining bots might investigate physically, making the task of analysis easier (apply a +30 modifier when physical sampling of an object is possible).

Academics: Ecology: This skill is used to analyze habitat ecospheres and make plans for keeping them in healthy balance. Sometimes this involves working with life support engineers to adjust air and water chemistry. Other times, habitat ecologists provide parameters for what they need done to the environment to someone with skill in Profession: Biodesign, who then creates organisms to meet those parameters. In the outer system, habitat ecologists may also use the Research skill to find an open source organism that meets their needs, bypassing the need for a biodesigner. In this case, they simply download the recipe for the desired organism and have someone skilled in Medicine: Biosculpting create it. Habitat ecologists may also work with habitat ops people to plan resource harvesting. The Jovian Republic has had an ongoing problem with habitat sepsis on their Reagan cylinders due to a dearth of people well schooled in this skill and in Profession: Biodesign.

Profession: Biodesign: Genetic designers are vital to the success of large habitats. In concert with Academics: Ecology, this skill is used to design the custom organisms that maintain ecological balance and healthy environments. Big habitats normally have a dedicated staff of two to twenty permanently employed biodesigners, supplemented by AIs. In the outer system, where there are many small habitats, competent traveling biodesigners tend to hold high rep scores and are always welcome guests. IIT Mumbai on Mars, the Gerlach habitat in Venus orbit, and Profunda Collegium on Enceladus all have strong reputations for educating biodesigners. This skill covers designing organisms whose behavior and chemical footprint produces the desired effect on a station environment, based on parameters given by someone with Academics: Ecology skill. Actual execution of the design is done using Medicine: Biosculpting, with this skill used as a complementary skill.

Profession: Habitat Admin: Covers knowledge and procedures needed to manage the workings of a habitat from a high level. Typically only medium to large habitats need people with these skills. Smaller stations are easily handled by AIs. Tasks covered by this skill include things like setting immigration quotas relative to available resources, budgeting raw materials usage, and financing maintenance and improvements (or, in the outer system, figuring out how to get needed help from neighbors).

Profession: Habitat Operations: Covers procedures and techniques for doing the detail work of day-to-day habitat functions. Just about every colony needs someone with some Habitat Operations skill, although for small stations this might only be one person. This is also the most widely applicable of the skills listed here for Firewall investigators. Hab Ops covers tasks such as planning mining ops, interpreting data from life support and recycling systems, balancing power grid usage, aligning external mirrors to create day/night cycles, operating reactors, setting life support parameters, allocating drones and service animals, and scheduling infrastructure maintenance. Spaceship captains and leaders of swarm habitats use a similar skill, Profession: Fleet Ops.

Profession: LSRS (Life Support and Recycling Systems): This skill deals with the nuts-and-bolts workings of these systems, from the small-scale chemical/nanotech systems used aboard space ships to the massive biological systems used on large habitats. On most habitats, CO^2 scrubbing and oxygen replenishment are performed mostly by plant life, be they concentrated vats of algae or the trees and grasses growing in habitat parklands.

Profession: Mesh Networking: Covers the topology and interactions of overlapping networks, including hierarchy, links, and master-slave relations. Useful for mapping out habitat mesh networks, finding out which system handles particular data or functions, and what systems can be hopped to from another.

Profession: Mining: Used to plan mining and resource harvesting operations, including coordinating transhuman work crews and autonomous mining bots.

Profession: Security Procedures: Used for setting up or analyzing security systems, surveillance coverage, checkpoints, and security responses. Can be used to tailor security protocols to specific situations, deduce likely responses or hidden features, or to find gaps in the coverage to be exploited. ■

low sounds in the 400–1,000 Hertz range (as opposed to the 20–20,000 Hertz range enjoyed by most transhumans) and hears poorly when not underwater. Apply a –30 modifier to any hearing-based Perception Tests. At the gamemaster's discretion, certain medium and high-frequency sounds may be inaudible as they are outside the morph's range.

This lack of hearing may be compensated for with audio implants or microphones and mesh inserts.

Impaired Linguistics

Bonus: 10 CP (Level 1) or 20 CP (Level 2)

This trait is only available to uplifts. This uplift's particular brain structure has difficulty processing language. At Level 1, the uplift loses some of their ability to speak, read, and comprehend things spoken by others when they suffer from stress. Each time the uplift suffers a trauma, they must make a Language Test at –10 to speak (both verbal and via mesh inserts) or comprehend (reading or listening) anything above the most basic words and information. This test only needs to be made once for each language, but for each additional trauma suffered, the test must be made again, with an additional cumulative –10 modifier. If the uplift loses their language abilities, they will recover them when that particular trauma is healed. In the meantime, they can only convey and understand basic, one-word, one-syllable concepts, such as "eat" or "run."

At Level 2, the uplift's language centers are permanently hobbled. Their free natural Language skill at character creation is 40 + INT, and no Language skill may be raised above 60. Additionally, they must make make a Language Test to convey or comprehend particularly complex information or sentences at a –10 modifier. At the gamemaster's discretion, this may also impair other skill tests, particularly Knowledge skills when dealing with detailed data or specialist terminology. Level 2 does not incorporate Level 1 effects.

Shut-In

Bonus: 15 CP

This character is a social hermit or went through a period of self-imposed isolation, limiting the amount of interactions they have via online social networks. Because the character is out of touch, their ability to network with others is impaired. Apply a –10 modifier to Networking Tests.

Stalker

Bonus: 10 CP

A voyeur obsessively stalks this character's actions online. The gamemaster and player should work out details of the stalker together, and the gamemaster should use the stalker as a plot element to create occasional nuisances and challenges. The stalker could, for example, be a fan who over-appreciates the character's work and pesters them or a unknown entity that follows the character's actions religiously and posts the details to an online log.

Stolen Identity

Bonus: 10 CP

Someone stole this character's identity and took advantage of their name, reputation, background—the works. Though this happened in the past, the situation was never fully resolved and the character is plagued with collateral difficulties from the theft. The gamemaster and player should work out details of the incident together, and the gamemaster should use this to occasionally hinder the character or create complications. For example, the character may have to deal with criminal charges against them in one habitat, angry thugs looking for payback on another, and so on.

Wait, That Was You?

Bonus: 10 CP

This character was the unfortunate star of a viral meme that swept through the solar system's mesh networks—provoking anger, disgust, or mockery towards them. To this day, strangers who access the character's social profile are likely to connect them to

CHICKCHARNIE POD BIOMORPH ■ p. 142

that meme, coloring their perception of the character. Once per game session, the gamemaster may decide that a stranger with whom the character is interacting and who has access to the character's online public profile makes the connection. The character suffers a one-time –20 modifier to any social skill or Networking Test with that stranger.

Weak Grip (Morph Trait)

Bonus: 10 CP

This trait is only available to neo-avian and neo-pig morphs. The physiology of this particular morph is flawed in that the opposable digits on the hands are not fully formed or operational. A character in this morph loses their damage bonus in melee attacks and suffers a –10 modifier on subdual tests (p. 204, *EP*) and any other tests involving their grip, hand strength, or ability to hold on.

New Gear

This section details new mods, equipment, bots, and vehicles.

Bioware

These physical augmentations follow all standard rules for implants as given in the *Eclipse Phase* core rulebook. Polarization and ultraviolet vision are also available in cybernetic form for synthmorphs.

Polarization Vision

Characters capable of seeing polarized light can view an aspect of light most humans only see weakly. Polarization reveals visual characteristics much in the way that color does for normal vision: it enhances contrast, foils camouflage, and helps to detect patterns and objects, particularly in light that is reflected off a shiny surface or scattered through the atmosphere or water. One major use of polarization is easier orientation in relation to polarized light sources (such as navigating underwater by the direction of sunlight). It also allows better detection of water surfaces, reflective surfaces, and certain patterns made in the water or on skin (which can be created by chameleon skin). Polarization vision can discriminate watery surfaces from mirages and better detect transparent objects. In game terms, polarization vision allows the character to ignore negative visual Perception modifiers for camouflage, transparency, or viewing underwater. At the gamemaster's discretion, it may provide a bonus modifier for Perception Tests to detect patterns and Navigation Tests where orientation to light sources is beneficial.

Octomorphs have natural polarization vision by default. **[Low]**

Scent Affinity

This modification may only be applied to smart animals. This particular animal has been modified to identify and trust a particular scent or pheromonal signature. Anyone giving off this particular olfactory signature receives a +30 modifier to Animal Handling Tests against this creature, assuming the critter can smell them. Trainers, smart animal handlers, and wealthy owners use this bioware to maintain better control over their pets/investments. **[Trivial]**

Ultraviolet Vision

This is a minor enhancement, simply adding perception of ultraviolet frequencies (p. 303, *EP*) to the character's visual capabilities. Neo-avians have natural ultraviolet vision by default. **[Trivial]**

Cyberware

These modifications follow all of the standard rules for cybernetic implants as given in the *Eclipse Phase* core rulebook.

Cybercortex

Similar but less sophisticated than a cyberbrain, a cybercortex is a limited artificial version of the neocortex for smart animals. A cybercortex is not sufficient to raise an animal to sapience, but it does boost the animal's ability to learn, comprehend instructions/commands, and reason. Apply a +10 modifier to Animal Handling Tests with this animal. The cybercortex also overrides many instinctive behaviors that would be undesirable in a service animal. **[Low]**

Implant Masking

Implant masking is not a separate implant, but a modification to an existing one. Masked cybernetic implants are composed of electromagnetic- and acoustic-absorbent smart materials that are less likely to be detected by surveillance and security systems using radar, x-rays, or ultrasound. Apply a –30 modifier to any attempts to detect the implant. **[Increase the masked implant's cost by one category]**

Life Recorder

Not everyone wants to broadcast their lifelog, whether for public viewing or for private storage elsewhere on the mesh. Some people want to retain a lifelog, but prefer to avoid possible interception of the contents online. Certain security, spy, political, and diplomatic professions may mandate this. Others may commonly

OPTIONAL RULE: UPLIFT GSPS

As noted in the *Uplifts* chapter, many uplift morphs come with built-in planned obsolescence as a method of tying the uplift to its patron corp. Much like many rusters on Mars, these morphs require semi-regular genetic service pack maintenance to avoid suffering from physical maladies.

Using this rule, most uplift morphs come with the Planned Obsolescence trait (p. 165, *Sunward*). In this case, reduce the CP Cost of each morph by 5 and reduce its Credit cost by one level (or by 10,000 if more than Expensive). ■

find themselves in situations where they are cut off from regular mesh access (such as gatecrashers or remote asteroid herders). Most people also don't want to be bothered with carrying a storage device on their person at all time. In these cases, a life recorder serves the purpose. The life recorder is a micro-sized memory diamond storage device, typically implanted in the head (though occasionally elsewhere in the body). This implant records all sensory input as experienced by the brain to which it is linked. Life recorders are designed as one-way information receivers, simply storing data until they are removed; they are not meant to be accessed, much like cortical stacks. **[Low]**

Memory Lock

This implant, when activated, prevents information from being stored in the subject's long-term memory or from being recorded via lifelog, mnemonic augmentation, or other sensory link. It also temporarily blocks up-to-the second cortical stack backups. The individual will retain short-term memories, but for no more than a few minutes. This implant is usually a requirement for personal aides, consultants, and other underlings of powerful people. The implants can be remotely activated by the superior during confidential meetings or other secret affairs to ensure privacy and deniability. This implant is also a popular option among some personal couriers who intentionally retain no memories of the party that hired them in case they are intercepted. **[Low]**

Sense Filter

This implant enables a character with a biological hyperspectral enhanced sense (enhanced hearing, smell, or vision) to filter out certain wavelengths and inputs like an equivalent technological sensor device. Normally a person with enhanced vision would experience terahertz, infrared, standard visual, ultraviolet, and gamma ray frequencies all at once. With this implant, however, they can tune out some wavelengths, ignoring them while still seeing the others. The same effect applies to audio or olfactory input, and the filter also allows the user to isolate specific noises or smells, canceling out sensory clutter or focusing on a specific source. This implant must be acquired separately for each sense. **[Low]**

Nanoware

These implanted nanosystems follows all of the standard rules for nanoware as given in the *Eclipse Phase* core rulebook.

Gait Masking

Gait masking nanosystems alter the bone density, muscle tone, and shape of the user's feet and legs in minute but effective ways, altering their gait pattern just enough to avoid detection. The process of reconfiguration takes 20 minutes. Gait masking is illegal in many habitats. Gait masking can also be used to mimic an existing gait profile; apply a +30 modifier on Disguise Tests to fool gait biometric scanners. **[Expensive]**

Nanotat ID Flux

This highly illegal system is a programmable version of the nanotat ID. Any new (fake) ID may be programmed in, and the nanotat may be reconfigured in seconds (1 Action Turn) to switch to another ID pattern in storage. This nanoware may not be configured for legal IDs unless they are actually legal or their encryption has been cracked. **[Expensive]**

Skeletal Disguise

This implanted nanobot system is designed to disguise a subject's skeletal structure and create false sensor readings, either to avoid identification or to mimic an existing skeletal pattern. An existing pattern can only be mimicked if the character is of equivalent body mass and size. Altering the skeletal signature takes 20 minutes. Apply a –30 modifier to the scanner system's Perception Test. **[Expensive]**

Robotic Enhancements

These alterations follow all of the standard rules for robotic enhancements given in the *Eclipse Phase* core rulebook and are only available to synthmorphs, vehicles, and bots.

Invisibility

This enhancement works much like the invisibility cloak (p. 316, *EP*). The shell is completely sealed within a layer of metamaterials with a negative refractive index, making it invisible to the microwave and ultraviolet wavelengths and everything in between. This modification can only be applied to shells on which the entire outer surface can be coated (ionic, roller, snake, thrust vector, walker, wheeled, winged). At the gamemaster's discretion, this enhancement may not be applied to certain shells due to their configuration. Shells with this enhancement are effectively blinded, as they cannot use visual sensors (though they can view via meshed remote sensors), though they can also create temporary "windows" as with invisibility cloaks. This mod is not compatible with the radar absorbent, reduced signature, or radar invisibility mods. **[Expensive]**

Radar Absorbent

The shell is constructed with materials that either pass, absorb, or trap radar and terahertz waves, reducing its sensor signature. Though sensor processing has improved significantly, radar absorbent materials can still provide some protection from detection. Apply a –20 modifier to detect the shell with radar and terahertz frequencies. This mod is compatible with the reduced signature mod. **[Moderate]**

Reduced Signature

This shell has been structurally modified to provide a much smaller radar cross-section. Shells with this modification have a very obvious streamlined, rounded and/or angular look, with no bulky pods or modules. External engines are instead incorporated

into the frame. This enhancement is normally only applied to winged, rotorcraft, ionic, or thrust vector shells; apply a –30 modifier to detect these shells with radar and terahertz frequencies. For all other shells, a –10 modifier is applied. This modifier may not be applied to hoppers, tracked shells, or walkers while they are moving, as their mobility systems negate the advantage. The modifier from this enhancement is cumulative with the radar absorbent enhancement. **[High]**

Radar Invisibility

This shell is coated with a layer of radar-transparent metamaterials with a negative refractive index. It is effectively invisible to radar waves; they simply bend around the shell as if it were not there. The shell cannot be detected by radar, but is visible at other frequencies. This mod is not compatible with the invisibility, radar absorbent, or reduced signature mods, nor may it be used in conjunction with an invisibility cloak. Shells with this mod cannot detect radar themselves. **[Expensive]**

Communications Gear

Two new communications tools are available.

Neo-Cetacean Translation Device

This dime-sized device is worn behind the left ear. It perceives ultrasonic frequencies and translates the whistles, clicks, and bursts of neo-cetacean into the transhuman language of the user's choice and transmits it directly through the skull to the inner ear. The device is, of course, waterproof and works out to the range of normal neo-cetacean hearing. A linked ultrasonic emitter, usually worn on the belt, allows for translation in the other direction. Neo-cetacean is a primitive language, and translations are often muddy at best. This device has Exotic Language: Neo-Cetacean at 50. **[Low]**

Hypersonic Communicator

This device allows the user to transmit audio in a beam, so that the directed sound is only audible at the targeted position. When pointed at a person, the target will hear the transmission as if the sound were in their own head. Used commonly for advertising, museum displays, art galleries, and similar purposes, portable hypersonic beam devices also enable people to communicate without fear of eavesdropping and without having to rely on insecure mesh transmissions. The drawback to hypersonic beams is that they are line of sight and will be disrupted by anyone or anything passing through them, so they are ideal for close quarters or non-busy environments. Hypersonic communicators are small devices. They do not work in vacuum, but in atmosphere the beam is unaffected by nearby loud noises. **[Low]**

Covert and Espionage Technologies

These technologies include a number of counter-surveillance tools employed by people who have something to hide or simply seek privacy, in addition to the usual spies, agents, and saboteurs.

Acoustic Spotter

This medium-sized but portable sensor system features an array of microphones and a swivel-mounted camera and laser rangefinder. When activated, the system detects the audio signature of kinetic weapons fire (or another programmed sound signature) and attempts to focus the camera and rangefinder on the source. In the case of standard firearms (or seekers or similar projectiles), the system detects the muzzle blast, the shock wave of the incoming bullets, and the difference in timing between them in order to triangulate the originating position. The location of the detected source, including the camera visual feed and range data, are fed into a meshed tacnet. The spotter's AI has Perception 40 and receives a +10 modifier for detecting sounds, +30 in the case of firearms (but not railguns), seekers, etc. The system can hone in on a repeating audio source; apply a +10 cumulative modifier for each additional emission/attack. **[Moderate]**

DNA Chaff

This small device is quite similar to a splash grenade (p. 341, *EP*), and may in fact be equipped and thrown like one. Its contents consist of nothing more than a mass of skin flakes and similar biological debris sampled from a thousand different biomorphs. The intent is to spread this material thoroughly over an area, effectively contaminating it for any purposes of collecting forensic DNA evidence. **[Moderate]**

Gray Box

A gray box is a simple wireless interface with its own power supply. It is micro-sized, about the size of a grape, with a set of smart universal ports and a nondescript, matte-gray housing. When attached to an existing device, it allows that device to be interfaced via a wireless connection. Gray boxes are used by infiltration specialists to add wireless interfaces to air-gapped wired networks or to objects, such as airlocks, that are designed to operate without them. Installing a gray box is a Task Action with a timeframe of 2 minutes (in addition to any Hardware Tests required to gain access to the target object) and requires appropriate tools.

Gray boxes normally operate in a passive mode, listening for signals from their operators but not emitting any signal of their own in order to avoid detection. Once a gray box has been activated, however, it will emit active signals until deactivated again. Gray boxes automatically stealth their signals (–30 on Interfacing Tests to detect them).

How hard a gray box is to discover is left to the gamemaster's discretion and possibly the ingenuity of the person who placed it. Normal maintenance routines will usually turn them up over the course

of time. Perception or Hardware: Electronics Tests should be given to technicians who regularly check up on a piece of gear in which a gray box has been installed. The size of the gray box, however, makes it difficult to visually spot (–30 modifier). In passive mode, they are not normally subject to detection, but in active mode, they may be found with Interfacing Tests (p. 251, *EP*). It is also possible that a security AI or hacker who is watching over an object or network may detect a gray box if someone uses it to intrude on the system and triggers an alert or if they happen to be auditing the system and detect an anomalous port connection. **[Moderate]**

Lens Crazer

A more offensive version of the dazzler (p. 316, *EP*), the crazer does not simply dazzle and overload the cameras it detects. It attempts to crater, pit, and scratch their lenses, effectively ruining their optic systems. Once activated, the crazer takes one Action Turn to detect lenses, then begins systematically zapping them. Stationary cameras are targeted first.

For combat situations, treat the crazer as if it has Beam Weapons 40, Initiative 5, and a Speed of 3. It will use its actions to aim; modifiers for laser sights and called shots cancel out. Its laser fires in SA mode. Though it only inflicts 2 DV with its attacks, targeted optics will suffer –30 on Perception Tests after the first hit and will be blind after the second hit. These effects last until repaired. **[High]**

Lens Spotter

The lens spotter is a less-intrusive version of the dazzler (p. 316, *EP*). It simply maps out all of the camera lenses in an area, noting their position and likely area of coverage, without blasting them with dazzling lasers. This system is used to unobtrusively detect the surveillance coverage in a given area so that a route map may be generated to avoid camera fields of view. It is also used by military and security forces to detect snipers or enemy spotters before they attack. **[Low]**

Privacy Pod

Privacy pods are portable self-assembling tent-like structures used to create secure rooms protected from eavesdropping. Privacy pods are effectively soundproofed Faraday cages, blocking all electromagnetic emissions. They feature a built-in guardian nanoswarm hive that watches for and counteracts any smart dust or other nanosurveillance systems. A privacy pod takes only 3 Action Turns to erect itself and supplies breathable air to the occupants. It features an airlock/scanning chamber with a built-in bug zapper (p. 291, *EP*). A repair nanohive monitors the pod's perimeter for any attempts to penetrate the walls. **[High]**

Radar Cloak

This cloak works like the invisibility cloak (p. 316, *EP*), except that it bends radar frequencies and makes the wearer invisible to radar sensors. **[High]**

Shroud

Also known as a privacy cloak or a "Gabby Coat," after the designer, Kalim Ghabil, a shroud is a whole-body smart-fabric covering, similar to a burkha, designed to provide as much anonymity as possible to the wearer. Electrostatic elements randomly stiffen, mold, and relax to mask gait analysis, foot covers change shape and redistribute weight to throw biometric analysis, and the entire garment emits randomly shifting heat patterns, pheromones, and odorants and broadcasts white noise to mask sounds and conversations from eavesdropping. The person inside cannot be detected with normal vision; the shroud blocks t-ray, x-ray, and infrared scanners (note that the shroud does not hide from view like an invisibility cloak; these scanners detect the shroud's presence quite easily, but they cannot get a reading on what is underneath). Gait analysis will also fail to recognize the shrouded person. An electrical field may be activated in the shroud's surface to block all wireless radio signals; this cuts the wearer off from the mesh, but also defeats any attempts to wirelessly track them and silences any bugs or tracking devices they may unknowingly carry.

Shrouds are an acceptable form of personal privacy in some habitats, but are considered unusual or may even be illegal in others. **[High]**

Drugs and Chemicals

Use the rules for drugs starting on p. 317, *EP*.

Hydra

Hydra only affects neo-octopi physiology. Specifically, it provides a euphoric sense of detachment to the ego while also boosting the autonomous activity and unconscious reflexiveness of neo-octopi arms, which already tend to act on their own accord. Though it does not (usually) impact the ego's control over their arms, any arms that are idle simply do their own thing. The gamemaster decides if and when these arms act and what they do (or, for more fun, you can assign an arm to each other player). The arms mostly act reflexively—recoiling from danger, grasping on to nearby objects—but sometimes act as if with intelligent direction, striking opponents, snatching forgotten objects, opening doors, etc. The arms use the octomorph's Initiative and skills. **[Low]**

Kong

Kong is a potent drug cocktail that boosts the aggressiveness of non-human primates. Uplifts and smart animals under the influence of kong must make a WIL x 3 Test or automatically attack anyone that exhibits threatening behavior. Kong users can ignore the effects of 1 wound, receive a +5 SOM bonus and a +10 bonus on melee attacks, but suffer a –5 INT modifier. Once engaged in violence, the affected primate must make a WIL x 3 Test to not automatically attack the next nearest target. Attempts to control primates under the influence of kong suffer a –30 modifier to their Animal Handling Tests. Once

the effects of this drug wear off, the user suffers –5 SOM for an equivalent duration. **[Low]**

Raptor

Raptor is a strength-boosting drug that only affects neo-avians. It increases their wing power and speed, as well as boosting the grip of their talons. Apply a +5 SOM bonus and a +20 modifier to Flight Tests to increase movement (like Sprinting, p. 190, *EP*). **[Low]**

Staste

This drug increases an octomorph brain's ability to process sensory input from the chemoreceptors in their suckers. This gives an octomorph an enhanced ability to "taste" things akin to a bloodhound's sense of smell, only tactile-based. Apply a +30 modifier to Perception, Investigation, or similar skill tests based on smell. **[Low]**

Nanotechnology

This technology follows the rules for nanoswarms given on p. 328, *EP*.

Nanotat Eraser

This illegal nanoswarm treatment is specifically designed to penetrate the fingertips of morphs and eradicate all signs of the nanotat ID it carries. Erasing a nanotat ID takes about 5 minutes and itches like crazy. Though usually applied to a specific person as a treatment, criminals and terrorists have sometimes deployed nanotat-erasing nanoswarms in public areas, surreptitiously erasing the IDs from unsuspecting people as a means of confusing security forces engaged in an ego hunt. **[Expensive]**

Smart Plankton

Smart plankton is a nanoswarm variant of smart dust (p. 316, *EP*) designed for underwater use. The plankton nanobots are designed for aquatic movement and can communicate via flashing lights and infrasound. Like smart dust, smart plankton can record video, audio (including infrasound and ultrasound), water temperature, chemical traces, as well as movement and other data. **[Moderate]**

Sensor Systems

The devices described here find widespread use in habitat surveillance systems.

Brainprint Scanner

This portable skullcap extrudes ultra-sensitive nanoelectrodes into the scalp, then plays media to the subject via a visor and ear plugs. It takes approximately 5 minutes to thoroughly scan a subject's brain patterns in response to the media, producing a verifiable brainprint which can then be authenticated against a meshed database entry. **[Moderate]**

Fiber Camera

This camera system is composed of multilayered semiconducting polymer fabrics that perceive visual wavelengths much like a standard camera, only without the lens. This allows cameras to be built into clothing, drapes, carpets, etc. These camera systems lack lenses and so are immune to dazzlers, lens spotters, and similar systems. **[Moderate]**

Fiberoptic Microphone

Similar to the fiber eye surveillance camera, the fiberoptic mic is a flexible and mesh-controllable length of fiberoptic cable that can fit through cracks, small holes, etc. This device measures the laser reflections off of a sound-sensitive reflective diaphragm, recording audio that is transmitted back through the fiberoptic cable. Unlike standard microphones, fiberoptic mics are not effected by environmental heat, moisture, or magnetic fields. They have effective noise-canceling functions, high fidelity, and can record infrasound and ultrasound. Apply a +10 modifier to hearing-based Perception Tests. Fiberoptic mics are sometimes strung throughout habitat infrastructure to monitor seismic vibrations in walls and other surfaces.**[Low]**

Flat Camera

Flat cameras rely on an array of tiny, networked micro-lensed imagers. With no large lens, these systems are flat and so are easily mounted on walls, ceilings, shell exteriors, and other surfaces. They are difficult (–20 modifier) to visually spot, but are detectable with lens spotter systems. Flat cameras are available in standard visual, infrared, and ultraviolet wavelengths, or a pricier hyperspectral model. **[Moderate; High for hyperspectral]**

Ghost Imagers

Ghost imagers are special camera systems that rely on a paradoxical effect to construct images of objects that conventional cameras cannot see, such as

Uplift Drugs

Drug	Type	Application	Onset Time	Duration	Addiction Modifier	Addiction Type
Hydra	Chem	Inj, O	20 minutes	3 hours	–10	Physical
Kong	Chem	Inh, Inj, O	3 Action Turns	1 hour	–10	Physical
Raptor	Chem	Inj, O	20 minutes	1 hour	–10	Physical
Staste	Chem	Inj, O	20 minutes	3 hours	–10	Physical

targets obstructed by smoke, clouds, or other visual effects. Ghost imagers rely on two cameras. The first is pointed at a light source and the second at a target object or location illuminated by that source (but obstructed from the standard camera view). By exploiting a (quantum) correlation effect in the property of light, the ghost imaging system can build an image of the target based on photons that are scattered off of it, even though the view of the target is obstructed. Ghost imaging could thus be used to see targets on a battlefield obscured by heavy fog or smoke or on a planet surface below heavy cloud cover, simply by pointing a camera that way and another at the sun, moon, or other light source.

In game terms, ghost imagers ignore all visual modifiers. Ghost imagers can see in infrared as well as standard visual frequencies. Though they are passive sensors that use natural light, they can also be used in conjunction with active light sources. **[High]**

Hyperspectral Imager

A hyperspectral imager views the electromagnetic spectrum much like enhanced vision bioware. The passive model perceives infrared to ultraviolet frequencies, while the active model incorporates terahertz and radar imaging as well. See the rules for hyperspectral sensors, p. 162. **[Moderate for Passive, High for Active]**

Hyperspectral Microphone

A hyperspectral mic hears the entire audio spectrum, from infrasonic to ultrasonic frequencies, much like enhanced hearing bioware. See the rules for hyperspectral sensors, p. 162. **[Moderate]**

ID Scanner

This small hand-held device is used to read the nanotat IDs carried by most morphs (p. 279, *EP*). It scans the nanobots, decodes the data, and compares the information against linked online databases. To truly be effective, this device must have mesh access to ID databases. **[Low]**

Metal Detector

Metal detectors use very-low frequency induction to detect metals that are not apparent. They can be used at security checkpoints to locate weapons, cyberware, or contraband. Available as hand-held wands, they are also often used as portal access systems, scanning anyone that passes through. Modern detectors are good enough to identify the type of metal. Gatecrashers and scavengers also use them to locate items buried in the ground or under debris. These devices have a very short range, just 2 meters, though larger masses of metal may be detectable from further away. **[Low]**

Motion Detector

Modern motion detectors use a combination of sensor technologies to maximize accuracy and reduce false alarms. They can operate in passive and active modes. In passive mode, the detector relies on infrared sensors to detect body heat, without sending out any signals that might betray its presence. In active mode, it sends out ultrasonic pulses and/or microwaves, measuring the reflections that bounce off a moving target to measure speed, position, and direction. Often strategically mounted as a perimeter security system, motion detectors are typically set in passive mode first, which then triggers active mode when it gets a reading. These devices are small. **[Low]**

Personal Interaction Sensor

These mini-sized combo sensors are worn on the body and use an infrared heat sensor, biolidar pulse rate measurement, pheromone and perspiration identification, and a camera and microphone to scan those with whom the wearer interacts. The sensor's AI measures the readings and also applies voice analysis (stress factor and response spaces) and kinesics assessments to judge the honesty and forthrightness of a conversational partner. While originally designed for business and political negotiations, PI sensors are growing in popularity as a tool for regular personal interactions. The AI is equipped with Kinesics and Perception skills of 40. They apply a +20 modifier to Kinesics Tests. **[Moderate]**

Quantum Dot Camera-Displays

These fullerene devices acts as both high-resolution display and camera. They can be painted on almost any surface. Because they do not have lenses, they cannot be detected by lens spotter systems. When not displaying images, they are also difficult to spot visually; apply a –20 modifier. They are hyperspectral, sensing from near-infrared to ultraviolet wavelengths. **[High]**

Quantum Radar

These advanced radar systems employ entangled emissions to acquire a higher resolution, similar to using a shorter wavelength. Quantum radar produces images with detail equivalent to terahertz or infrared, making it better for detecting concealed objects and targets. Apply a +20 modifier to Perception Tests made with quantum radar systems. **[High]**

Sensor Concealment

Many sensors are hidden within everyday objects or constructed to look like something different so as not to be an obvious surveillance tool. This modification to a sensor device applies a –30 modifier to Perception Tests made to spot it and identify it as a sensor. **[Low]**

Super-Wide Cameras

Carried by aerial drones and orbital satellites or mounted at high infrastructure points like habitat domes or the axis points of cylinder habitats, these cameras can view an area up to 300 square kilometers in size down to 0.1 meter resolution. They can view

in standard visual, near infrared, or ultraviolet; hyperspectral versions are also available. **[Moderate; High for hyperspectral]**

SERVICES

These services are available through legitimate or black market channels.

ANIMAL CARE

Though smart animals are sometimes self-sufficient, any animal caretaker who plans to be away for an extended period likely needs to have someone make sure their critters get food, water, and exercise. **[Low per week; Moderate for large animals]**

ANIMAL TRAINING

Smart animals take well to training, but not everyone has the time, inclination, or patience to do it right. Professional animal trainers provide this service, teaching them commands and new skills. See *Smart Animal Training*, p. 175, for estimated timeframes. **[Moderate per month]**

BLIND SPOT/ROUTE

Certain groups intentionally create or maintain "blind spots" in public areas that are free of surveillance coverage. These are then rented out to those who need to conduct a discreet transaction, switch disguises, or otherwise do something without being seen or leaving a record. These blind spots rarely last long; new ones must be created. For a greater expense, a painstakingly mapped route can be purchased that carefully winds its way without crossing through the coverage area of any sensors. These routes are rare and hard to maintain; it is unlikely that you can shop for a route in a specific area, but they are good for setting up a meeting in a location with an unwatched escape route. Alternatively, at even greater expense, it is sometimes possible to pay criminal groups to create a temporary route for you along the path of your choosing. **[High or more]**

CRYPTO-CRED

Crypto-cred is anonymous, encrypted currency. It is used by those who wish to purchase black market goods, hide their transactions, launder money, or avoid taxes. It is illegal in some habitats, but remains in heavy use, especially with criminal cartels. Acquiring crypto-cred is as simple as buying it with credit via an anonymized transaction with a secure crypto-cred server. The encrypted crypto-credits can then be signed over to other parties, who can redeem them through a similar service. There is a 10% fee to exchange crypto-cred with credit and vice versa, but there is no cost to exchanging crypto-cred between people.

ID PROTECTION

Various hypercorps offer ID monitoring services to protect against ID theft and fraud, alerting the user of suspicious events and activity. At a greater expense, the corp offers active protection, alerting local authorities, tracking down potential abusers, and blocking future unauthorized transactions. **[Low for one year of monitoring; Moderate for one year of active protection services]**

PRIVACY SUITE

Privacy suite services are offered by many restaurants, night clubs, hotels, and similar businesses who frequently have clientèle that desire a private space for meetings or other functions. These suites function similar to privacy pods (p. 151) and are regularly scoured for bugs. In some habitats, automated privacy hotels offer these suites as a walk-in or reserved service. **[Low per hour]**

PRIVATE SENSOR FEEDS

In addition to coverage of private areas, many public areas are seeded with privately owned cameras and sensors that are off-limits to public access. These sensors are sometimes higher-quality or have more capabilities than standard publicams. Some providers offer timed access or access to recordings for a particular time period for a fee, however. **[Low per hour]**

SMART ANIMALS

These partially uplifted animals can be found throughout the solar system.

BEES AND GARDENER WASPS

Both bees and pollen wasps have been genetically modified and interbred, creating several new species of insects that provide a valuable pollination service in habitat gardens. These swarms live in large nests/hives, produce honey, and prey on other insects, serving as a biological form of pest control. Some of these breeds are quite large, growing up to 8 centimeters in length. They adapt quite well to microgravity. Many have been trained to assist with other gardening tasks, such as collecting debris or trimming leaves. They are sometimes also used for security, when certain pheromonal cues are released, the entire hive will attack. These insects are smart enough to remember faces, but tales of smart wasps loaded with toxins and sent to assassinate certain morphs are likely rumors. Cost and statistics are for a swarm of 200. **[Low]**

Skills: Flight 60, Fray 50, Infiltration 30, Intimidation 30, Perception 30, Scrounging 40, Unarmed Combat 40

Enhancements: Enhanced Smell, Polarization Vision, Swarm Composition, Ultraviolet Vision

Movement Rate: 4/30

Attack: Sting, 1d10 DV

GUARD DOG

These smart dogs are trained for security or policing purposes and upgraded with bioweave, enhanced vision, hardened skeleton, and reflex booster implants. **[High]**

Skills: Fray 40, Freerunning 30, Infiltration 30, Intimidation 40, Investigation 40, Perception 30, Scrounging 40, Unarmed Combat 50

Enhancements: Bioweave (Heavy), Cyberclaws, Cybercortex, Enhanced Hearing, Enhanced Smell, Enhanced Vision, Hardened Skeleton, Mesh Inserts, Puppet Sock, Reflex Boosters
Movement Rate: 4/20
Attack: Cyberclaws, 1d10 + 5 DV, AP –2
Armor: 3/4

SMART HAWK

Enhanced versions of peregrine falcons and other predatory birds are common in large, open habitats, and the hobby of falconry has made a comeback. Some smart falcons have been trained for surveillance or security purposes, tracking or finding subjects from overhead. **[Moderate]**
Skills: Flight 60, Fray 50, Infiltration 30, Perception 50, Scrounging 40, Unarmed Combat 40
Enhancements: Claws, Enhanced Hearing, Enhanced Vision
Movement Rate: 4/40
Attack: Beak/Claws, 1d10 + 2 DV, AP –1

SMART RACCOON

Raccoon helpers are employed as personal assistant and for many of the same tasks as smart monkeys. Some are even trained to get along in free fall, though they are mostly found in habitats with real or spin gravity. **[Moderate]**
Skills: Climbing 40, Fray 20, Freerunning 20, Infiltration 40, Perception 30, Scrounging 40, Swimming 30, Unarmed Combat 20
Enhancements: Enhanced Hearing, Enhanced Smell, Grip Pads
Movement Rate: 2/8
Attack: Bite, 1d10 – 4 DV

SMART CAT

Though smart cats deign to let humans pet and feed them, they are even more stubborn and independent than their baseline forebears. Nevertheless, some have been trained for surveillance and other purposes. **[Moderate]**
Skills: Climbing 30, Fray 30, Freerunning 30, Infiltration 40, Perception 30, Scrounging 30, Unarmed Combat 30
Enhancements: Claws, Enhanced Hearing, Enhanced Smell, Enhanced Vision
Movement Rate: 4/20
Attack: Claws, 1d10 + 2 DV, AP –1

SWARM CAT

Swarm cats (p. 116) are the creation of scum gene-hackers. No two swarm cats tend to be alike—many of them are more like hyenas or mongooses—and each is likely to have a unique assortment of enhancements. The statistics given below should be used as a rough guidelines for other cats. **[High]**

HYPERGIBBON POD BIOMORPH ■ p. 142

Skills: Fray 50, Free Fall 20, Freerunning 40, Infiltration 40, Intimidation 20, Perception 30, Scrounging 30, Unarmed Combat 50
Enhancements: Adrenal Boost, Basic Biomods, Claws, Cybercortex, Bioweave (Light), Eelware, Enhanced Hearing, Enhanced Smell, Enhanced Vision, Mesh Inserts, Neurachem (Level 1), Prehensile Tail
Movement Rate: 4/20
Attack: Claws, 1d10 + 2 DV, AP –1
Armor: 2/3

SOFTWARE

These programs and AIs adhere to the rules provided in the *Mesh* chapter, p. 234, *EP*.

ANIMAL KEEPER AI

Like a muse for smart animals, this AI overwatches a critter's activities, directs it as needed, and alerts the owners to any emergencies or other problems. If the animal is equipped with a puppet sock, it can also jam

it like a biodrone. COO 20. Skills: Animal Handling (Animal Type) 40, Interests: [Animal Type] 80, Interfacing 20, Perception 30, Research 20. **[Moderate]**

Behavioral Psych

When provided with data on a particular person and their activities, this software can build a psychological profile. The larger the data set—sensor scans, mesh activity, public profile, relationship maps, location tracking, medical history, lifelogs—the deeper and more accurate the analysis. Treat this as an Academics: Psychology skill of 80 or apply a +20 modifier to a character using this software to aid a psychology or behavior-related analysis test. **[High]**

Event Reconstruction Software

The latest forensic method used by crime scene investigators, event reconstruction software takes sensor data and applies predictive algorithms to build a reconstruction of a past event. This combined data can be used to run a simulspace scenario of the event and its possible permutations. Apply a +20 modifier to Investigation Tests. **[High]**

Fake Brainprint Plug-In

This software plug-in can be used by infomorphs or characters with cyberbrains to attempt to deceive brainprint scanners. Make a Variable Opposed Test between the Interfacing skill of the person or AI running the scan with a –30 modifier and the Infosec skill of the subject (or their muse). If the character being checked succeeds and the scanner fails, the fake brainprint passes. If both succeed, an anomaly has been detected, though the nature of the anomaly will be unclear. Further scans can be made to try and identify the problem (repeat the test). If the scanner succeeds and the fake brainprint user fails, the deception is detected. Another test can be made to identify the real print (without the –30 modifier this time), and the scanner will likely have some uncomfortable questions to ask. This software is considered contraband in most law-abiding habitats. **[Expensive]**

Kinesics Software

Kinesics software measures voice stress patterns or analyzes other sensory input to monitor for deception, hostile intent, and other emotional states. It functions with a Kinesics skill of 40 or provides a +10 modifier to a Kinesics Test made by someone using it. **[Moderate]**

Probability Mapping

Though most effective with massive data sets and quantum computers, a standard user and their muse can still benefit from using probability mapping software to predict things like traffic, peak travel times, crime rates, and other periodic and habitual events. When supplied with data on a particular person, this software can make a guess as to their likely current whereabouts, activities, and possibly even moods and other factors. **[High]**

Radio Motion Detection

Technically known as variance-based radio tomographic imaging, this sensing technique can be used with any wireless radio devices. It is especially useful in urban areas, where wireless devices are everywhere. Because this system is passive, using existing signals, it does not alert the target. To detect motion in a target area, the software measures and analyzes the transmission and reception of radio signals originating on opposing sides of the target area. Variations in these signals detect movement in the area, which can be overlaid on a map of the area to pinpoint target locations. Since wireless radio signals penetrate walls and other obstructions, this can be used to identify unseen movement inside a structure, without giving away the scanning as t-rays or radar would. This method is roughly accurate to within 5 meters, –1 meter per 10 points of MoS on an Interfacing Test. Resolution is poor, with few details on the target provided. **[Low]**

Relationship Mapping

This software uses publicly available data, as well as any other information supplied, to build a relationship map marking a specific target's known and likely associates and interactions. Aside from analyzing public profiles and online interactions, it also accesses mesh tracking logs to pinpoint incidents of physical proximity. It is useful for identifying a person's social relationships, including friends, relatives, lovers, co-workers, conspirators, and so on. At the gamemaster's discretion, this may provide a modifier for Investigation or Networking Tests. **[Moderate]**

CREATURES

CREATURE	COG	COO	INT	REF	SAV	SOM	WIL	INIT	SPD	DUR	WT	DR	LUC	TT	IR
Bees/Wasps	1	20	10	20	1	5	1	6	1	30	6	45	2	1	4
Guard Dog	5	10	15	25	5	20	10	8	2	35	7	53	20	4	40
Smart Cat	5	15	15	15	5	10	20	6	1	15	3	23	40	8	80
Smart Hawk	5	20	15	20	5	10	10	7	1	15	3	23	20	4	40
Smart Raccoon	5	10	15	15	5	10	10	6	1	15	3	23	20	4	40
Swarm Cat	10	15	15	15	5	15	15	6	2	25	5	38	30	6	60

Sensor AI

Sensor AIs are equipped in most off-the-shelf sensor systems. Skills: Hardware: Electronics 30, Infosec 20, Interests: [Sensor] Specs 80, Interfacing (Sensor) 40, Perception (Sensor) 40, Programming 20, Research 20. **[Moderate]**

Technician AI

Technician AIs are used on habitats and aboard ships to direct the work of repair drones. Skills: Hardware: Electronics 40, Hardware: Industrial 40, Hardware: Robotics 40, Infosec 20, Interfacing 40, Research 20, Perception 20, Profession: Habitat Ops 60. **[Moderate]**

Survival Gear

This gear is found on most space habitats as standby equipment for emergency situations.

Air Mask

This simple face-covering breathing mask comes with a small-sized air tank with enough air for 2 hours. A medium-sized air tank version, good for 12 hours, is also available. **[Trivial; Low for larger air tank]**

Oxygen Candles

In the event of a life support failure, a breathable atmosphere can be created in a pressurized space by using a solid-fuel oxygen generator. A standard portable medium-sized version produces 75 man-hours of oxygen once ignited. A smaller pocket-sized version produces 15 man-hours. **[Low for small; Moderate for medium-sized]**

Robots

These follow all of the rules given for robots in the core rulebook (p. 343, *EP*).

Bughunters

These airborne drones are designed to descend on a targeted area to find and eliminate all sensors. They are often used to clear a path for those wishing to move without leaving a record. Bugunter bot AIs have Interfacing 40, Investigation 40, Perception 40, and Seeker Weapons 40. **[Moderate]**

Caretaker

Caretaker bots look after smart animals so the owner doesn't have to. They feed and water them, take them for walks, play games, encourage exercise, and clean up their messes. They also keep in touch with the animals' keeper AIs (if they have them) and otherwise track and monitor their activities and health. Caretakers can also teach animals from a repertoire of common commands and skills. Caretakers tend to be boxy and wheeled, with two arms and various attachments for cleaning, grooming, leashing, etc. Each caretaker is customized for a specific animal species. Caretakers have Animal Handling 40, Interests: [Animal Species] 80, and Profession: Animal Care 80. **[Moderate]**

Hab Repair Bots

To cut costs, most habitat repair bots are standardized and versatile, used for purposes as diverse as conducting repairs in vacuum on a station's exterior hull to clearing blocked sewage pipes or repainting a

ROBOTS

ROBOT	MOVEMENT RATE	MAX VELOCITY	ARMOR	DURABILITY	WOUND THRESHOLD	MOBILITY SYSTEM
Bughunter	4/20	40	2/2	30	6	Rotor
360-Degree Vision, Access Jacks, Disassembly Tools, Electrical Sense, Enhanced Vision, Headlights, Image Recognition Software, Lens Crazer, Lens Spotter, Lidar, Radar, Specialized Hive with Guardian Nanoswarm, T-Ray Emitter, Utilitool, Weapon Mount with Seeker Pistol with EMP and HE seekers						
Caretaker	4/20	30	4/4	25	5	Wheeled
Access Jacks, Chem Sniffer, Image Recognition Software, Lidar						
Hab Repair Bot	4/16	20	4/4	40	8	Walker
Access Jacks, Chem Sniffer, Electrical Sense, Enhanced Vision, Extra Limbs (6–8), Grip Pads, Headlights, Maker, Nanoscopic Vision, Repair Spray, Tool Kit, Utilitool						
Harvester	12/200	NA	4/4	50	10	Thrust Vector
360-Degree Vision, Access Jacks, Extra Limbs (4), Enhanced Vision, Headlights, Radar, Radiation Sense, Tool Kit						
Skimmer	12/200	NA	12/12	100	20	Thrust Vector
360-Degree Vision, Access Jacks, Chem Sniffer, Enhanced Vision, Lidar, Radar, Radiation Sense						
Spider Hand	2/8	12	2/2	10	2	Walker
Access Jacks, Cyberclaws, Grip Pads, Pneumatic Limbs						
Stealth Drone	12/200	200 (air)/NA (space)	10/10	60	12	Winged, Thrust Vector
+10 COO, 360-Degree Vision, Access Jacks, Chameleon Skin, Enhanced Vision, Lidar, Quantum Radar, Radar Absorbent, Radiation Sense, Reduced Signature, Super-Wide Camera						

colony corridor. They are equipped with interchangeable tools and reservoirs for carrying stock materials. Most repair bots have a crab-like robotic frame. Repair bot AIs have Hardware: Industrial 40, Hardware: Robotics 40, and Perception 30. **[Moderate]**

Harvester Drones

Many microgravity habitats employ harvester bots to bring in outside materials, such as rock and ice, for processing into useful materials. Dense fields like Saturn's rings or trojan or orbiting debris clumps are relatively easy to mine because there are so many particles and chunks of material that can literally be grabbed with a drone's robot arms and propelled back to the station. These capture drones are disc-shaped to give a 360-degree reach from the main body and allow the plasma thruster in the center to be pointed through the center-of-gravity of any object. Most are no larger than 1.5 meters in diameter, with six to eight articulated appendages that can reach another four meters each. **[Moderate]**

Skimmers

Habitats in orbit around the gas giants—Jupiter, Saturn, Uranus, and Neptune—operate craft specifically designed to fill their tanks with atmospheric gases, like hydrogen and helium, and rocket back to the habitat for offloading. This is the primary method for collecting helium-3 for fusion reactors. Atmospheric mining craft—skimmers—must be adapted for their particular environment to safely operate. For example, Jovian skimmers require larger engines to overcome the planet's gravity well and heavier shielding for electronics. Even virtual crew operating the skimmer require some protection for their digital systems. Saturnian skimmers must deploy retractable stabilizers to maintain control in the high winds. Nuclear thermal rockets are common amongst all skimmers because of their high thrust-to-weight ratio and ability to use the ambient atmosphere as reaction mass. **[Expensive]**

Spider Hand

Named for the way it scurries and jumps like a spider, this robotic hand is normally used by neo-avians, neo-octopi, and neo-cetaceans who need a human hand design and/or some additional strength to handle certain tasks. It should be noted that the hand does not possess the leverage of a body behind it, so there are limitations to what it can do, though it can extend a meter-long brace for stabilization and support. They have an effective SOM of 10. **[Moderate]**

Stealth Drone

This stealth plane is designed to covertly penetrate airspace and monitor targets from overhead without detection. It can be used in vacuum as well as atmosphere. Its AI is equipped with Flight 40 and Perception 40. **[Expensive]**

Vehicles

These follow all of the rules given for vehicles in the core rulebook (p. 343, *EP*).

Flux Car (Aircraft/Groundcraft)

Flux cars are black market vehicles optimized for countersurveillance and tracking. Equipped with chameleon coating and constructed with smart materials, they can change their exterior appearance and even reconfigure their chassis on command. Both flying and ground car versions are available; flying car models come equipped with radar absorbent modifications. Most jurisdictions outlaw these designs. **[Expensive, Minimum 30,000 for ground, 40,000 for flying]**

Flux Cycle (Groundcraft)

This is an enclosed cycle (p. 344, *EP*) with the same features as a flux ground car. **[Expensive]**

Lifeboat (Spacecraft)

Habitat lifeboats are designed to carry up to 100 people with food and water for 8 days. They are not designed for long-term or long-distance travel and have only very small metallic hydrogen rockets with limited range and poor maneuverability. **[Expensive]**

Neo-Cetacean Walker (Exoskeleton)

This exoskeleton is designed for neo-cetaceans to move about in non-aquatic environments. It includes a set of arms for manipulating objects and can operate as a four-legged walker or as a thrust-vector sled. A cocoon-like wrapping keeps the neo-cetacean's skin wet and cooled in warmer environments. **[Moderate]**

Identification

These rules apply to identification scans as described in the *Surveillance* chapter.

Brainprint Scans

Brainprint scans of biomorphs in the field are conducted with a brainprint scanner (p. 152). Unless the subject's brain has been significantly modified in some way (serious mental trauma, head wounds, psychosurgery, heavy drug or narcoalgorithm use, etc.), this will produce a scan of the subject's brainprint for comparison with databases, no test required. If the gamemaster determines the scan may produce a deviant brainprint, make an Interfacing Test using the skill of the person or AI running the check, applying appropriate modifiers. If the test fails to produce a match, the subject will usually be taken in for a more detailed scan with full medical scanning gear (apply a +30 modifier to the Interfacing Test). Whether the brainprint matches up with database queries is up to the gamemaster or may be resolved with a Research Test using the skill of the person or AI running the check; the data integrity of the databases being checked may apply modifiers. Whether or not a brainprint gets a match, the brain

scans of AGIs and uplifts are automatically identifiable as non-human; apply a +30 modifier to an Interfacing Test for determining the subject's exact nature.

Cyberbrain and Infomorph Brainprints

Scanning the brainprint of someone with a cyberbrain or an infomorph brain-state is as easy as analyzing it with brainprint analysis software. This test takes only a Complex Action. If an Interfacing Test is called for due to a potential deviant brainprint, apply a +30 modifier. Infomorphs and cyberbrained characters have the option of trying to deceive a scan with a fake brainprint plug-in (p. 156).

Nanotat IDs

Verifying a nanotat ID with an ID scanner (p. 153) is an automatic affair. Morphs that have had their nanotat ID erased (See *Nanotat Eraser*, p. 152) or that never had one in the first place are likely to be viewed with extreme suspicion. Morphs using nanotat ID flux nanoware (p. 149) are unlikely to be questioned; the deception can only be detected under close medical scrutiny with a Medicine: Nanomedicine Test.

Sensor Rules

The following rules apply to sensor systems, whether equipped on a synthmorph, bot, vehicle, habitat, or device. Biological equivalents also follow suit.

Sensor Types

Sensors can be broken down into multiple categories.

Technological vs. Biological

Unless otherwise noted, the capabilities of biological sensor organs are equivalent to those of technological devices. Tech sensors are typically fully meshed and have an on-board sensor or device AI, whereas biosense input into the brain or cyberbrain can be accessed by mesh inserts and other implants and shared via tacnet, recorded for lifelog purposes, etc. Tech sensors are powered by small nuclear batteries, standard batteries, or locally broadcast wireless power feeds. Hyperspectral tech sensors can turn off or isolate certain frequencies, whereas biological sense organs perceive the entire spectrum of wavelengths (unless equipped with a sense filter implant, p. 149).

Active vs. Passive

Active sensors must actually emit signals, taking a reading based on the signals that are reflected back their way. This means, however, that active sensors can be easily detected by any other senses or sensors capable of detecting their signals (See *Detecting Sensors*, p. 160). Passive scanners, however, do not emit any signals that might give them away. They simply receive any signals that come their way, either natural or artificial. Any active sensor can be operated in passive mode, though it will only detect other active scanners of that type and any natural emissions.

Scanners vs. Software

A distinction must be made between the scanning device that actually receives input and then the software that analyzes it. Most sensors come equipped with analysis software overseen by the device's AI. A standard video camera, for example, records its visual input but does not detect anything on its own. Such a camera can be loaded with all sorts of software such as facial recognition, silhouette analysis, and so forth. Many sensor devices have this software running on their own electronics; sensors that are part of a larger security network, however, usually feed their data to a central processing node where security and sensor AIs oversee the data collected. Software systems can correlate data from multiple devices, acquiring a better picture of the situation than they could from a single sensor.

Sensor Size and Range

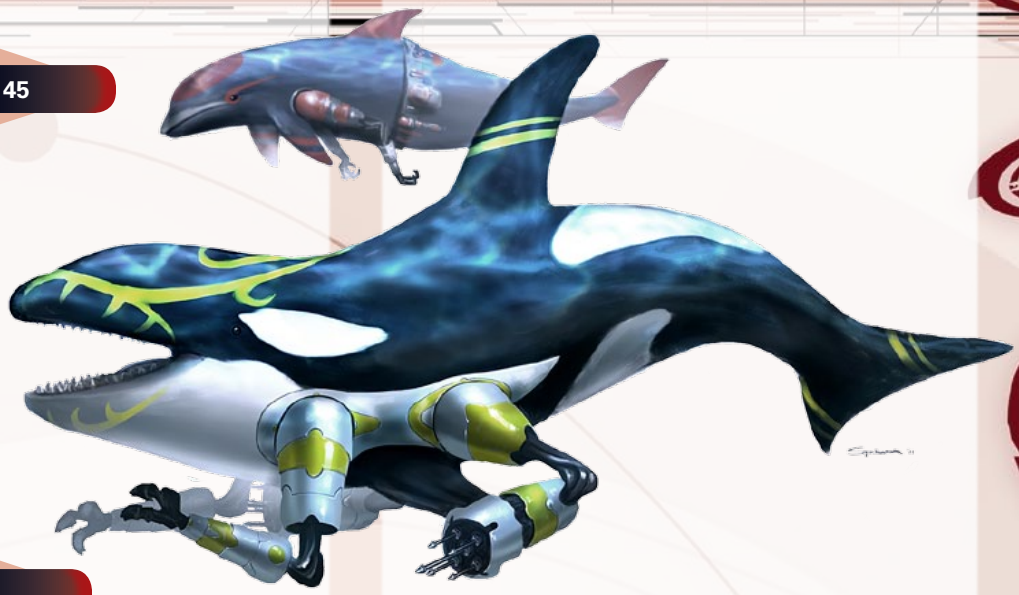
Sensors come in a range of sizes, just like other gear (see the Gear Sizes table, p. 297, *EP*). Standard portable sensors (p. 325, *EP*) are small hand-held and easily concealable devices. Most can also be obtained in mini or micro sizes at the same cost (if the gamemaster allows). At the gamemaster's discretion, some sensors may not be available at certain sizes. Radar, for example, does not come in a size smaller than medium, simply because the wavelengths radar operates on are "physically" large and so require a big enough sensor to read them. Nanoswarms carry nano versions of various sensors. A sensor's size determines its effective range, as noted on the Radio and Sensor Ranges table, p. 299, *EP*.

Many common, everyday objects contain sensors. Spimes can be found in habitat infrastructure, public seating, lighting fixtures, appliances, furniture, retail

VEHICLES

VEHICLE	PASSENGER CAPACITY	HANDLING	MOVEMENT RATE	MAX VELOCITY	ARMOR	DURABILITY	WOUND THRESHOLD	DEATH RATING
Flux Car (Flying)	4	0	8/60	180	20/10	150	30	300
Flux Car (Ground)	2	+10	8/40	180	20/10	150	30	300
Flux Cycle	1–3	+20	4/40	110	12/10	50	10	300
Lifeboat	100	–20	4/100	NA	20/20	200	20	400
Neo-Cetacean Walker	1	0	4/20	40	2/4	40	8	80

NEO-DOLPHIN BIOMORPH ■ p. 145



NEO-ORCA BIOMORPH ■ p. 145

displays, entranceways, rooftops, transit stops, and randomly embedded or stuck to available surfaces in public areas. Usually meshed and publicly accessible, they most commonly carry micro-sized flat cameras and sometimes others micro, mini, or small sensors, especially microphones or infrared.

Detecting Sensors

The ubiquity of sensors in public areas can make it a challenge to find all of them. This is especially true when you also take into consideration sensors and spimes carried on moving people, bots, vehicles, and infrastructure.

Visually spotting sensors can be hard given their often tiny size. Apply a –10 modifier to detect small sensors, a –20 to detect mini sensors, and –30 to detect micro sensors. An additional modifier may apply for sensors that are actively concealed (p. 153). Nanoswarm sensors cannot be spotted without nanoscopic vision, a nanodetector, or a nanoswarm of your own. If a character is attempting to visually spot all of the sensors in an area, treat it as a Task Action with a timeframe appropriate to the sensor coverage.

Active sensors can be detected by virtue of the signals they transmit. A passive radar sensor can be used to detect an actively scanning radar device, for example, or enhanced vision could be used to detect an infrared laser or a terahertz emitter's signals.

Public meshed sensors freely give away their locations. Identifying these and their placement is an automatic affair for anyone with mesh inserts. The wireless signals of non-public sensors are also easy to scan, unless they are stealthed, in which case an Interfacing Test at –30 must be made to detect them (see *Wireless Scanning*, p. 251, *EP*). Once the signals are found, they can be triangulated using readings from any three receiving devices (which almost every character is likely to have on their person) and a successful Interfacing Test to within a range of 50 meters, –10 meters per 10 points of MoS.

Several tools can also assist in detecting sensors, particularly the lens spotter (p. 151), electrical sense implants (p. 306, *EP*), and smart dust (p. 316, *EP*).

Using Sensors

In most circumstances, sensors can simply be assumed to work as advertised, no test necessary. Cameras record pictures, t-rays see through walls, x-rays detect implants, facial recognition IDs people, and so on. In

PERCEPTION AND SENSOR TEST MODIFIERS

SITUATION	MODIFIER
Sensor of inferior quality	–10 to –30
Sensor of superior quality	+10 to +30
Minor sensor impairment	–10
Standard vision: glare, light smoke, dim light	
Target: minor cover	
Moderate sensor impairment	–20
Standard vision: heavy smoke, dark	
Target: moderate cover	
Radar: biomorphs, small targets	
Major sensor impairment	–30
Standard vision: impenetrable fog	
Target: major cover	
Range	–10 to –30
Small target (child sized)	–10
Very small target (mouse sized)	–30
Large target (car sized)	+10
Very large target (barn)	+30
Hyperspectral sensors	+20
Multiple Sensors	+10 to +30
Detailed analysis	+10 to +30

circumstances where a sensor operation is impaired or where someone is actively trying to circumvent or fool the sensor, then a test is required. In this case, the Perception of the sensor's operator or its built-in AI is rolled. Treat this as a Success Test when operating the sensor under difficulty or as an Opposed Test against someone trying to evade or trick the sensor. Various modifiers may apply to this test, depending on the sensor and situation; see the *Perception and Sensor Test Modifiers* table (previous page) for some suggestions.

In circumstances where the sensor is guaranteed to work, but the quality of the sensor input is in question, a Simple Success Test using Interfacing skill can be rolled to gauge how well the sensor functions. For example, if a well-situated camera is trying to grab a shot of someone in an open but crowded square, an Interfacing Test by the operator or AI will determine if the picture is clear (success) or fuzzy (failure), with MoS or MoF determining the quality.

Sensor software relies on different skills to analyze different types of sensor data. Pattern-matching algorithms use the AI's Perception, sometimes with modifiers based on the size and quality of the database they are matching against. Other software may rely on various Knowledge skills, as noted. Chem sniffers,

COMPREHENSIVE SENSOR CHART

This chart details most, if not all, of the sensor systems available in *Eclipse Phase*.

SENSOR	SKILL	TYPE	NOTES
Chem Sniffer	Academics: Chemistry	Passive	Analyzes air; detects chemicals, explosives, firearms, exhaled carbon dioxide, body odor biometrics
Electrical Sense	Perception	Passive	Detects nearby electronics, electrical fields (including those of biomorph bodies)
Face/Image/Pattern/Biometric Recognition Software	Perception	Passive	Detects faces, gaits, images, irises, personal body odor, retinas, silhouettes, skeletons, sounds, voices, or other specified patterns
Ghost Imager	Perception	Passive	Ignores all visual modifiers under special conditions.
Hyperspectral Audio	Perception	Passive	Hears all audio frequencies, infrasound through ultrasound
Hyperspectral Imager (Passive)	Perception	Passive	Perceives infrared through ultraviolet
Hyperspectral Imager (Active)	Perception	Active	Perceives radar through ultraviolet
Infrared			
Near Infrared	Perception	Passive	Night vision; active infrared lighting applies bonus modifiers
Mid-Long Infrared	Perception	Passive	Detects heat and temperature differences
Chemical Imaging	Academics: Chemistry	Passive	Detects organic chemical composition via vibrational spectroscopy
Infrasound/Lateral Line	Perception	Passive	Detects vibrations, seismic effects, footprints, heart beats, movement; long range
Kinesics Software	Kinesics	Passive	Measure stress, hostile intent, truthfulness, emotional state
Lidar	Perception	Active	Measures speed, movement, range; useful for minute positional mapping
Chemical Imaging	Academics: Chemistry	Active	Detects atmospheric properties and weather
Metal Detector	Perception	Active	
Nanoscopic Vision	Perception	Passive	Sees nano-scale objects
Polarization Vision	Perception	Passive	Sees extra visual details
Pressure Sensor	Simple Perception	Passive	Detects any weight place upon it.
Radar	Perception	Active	Detects speed, movement, range, concealed objects, implants; works best on metallic objects; low resolution; sees through walls; reads pulse/respiration at close range
Quantum Radar	Perception	Active	Better resolution.
Radiation Sense	Perception	Passive	Detects radiation
Radio Motion Detection	Interfacing	Passive	Detects movement, speed, range based on existing wireless signals; poor resolution
Smell	Perception	Passive	
Standard Audio	Perception	Passive	
Standard Visual	Perception	Passive	
Terahertz (t-ray)	Perception	Active (Passive in space)	Mid-ground between radar and sight; penetrates walls but is blocked by skin, metal, and water
Ultrasound	Perception	Active	Detects movement, density; low resolution imaging
Ultraviolet	Perception	Passive	Some chemicals fluoresce under UV light
X-ray/Gamma ray	Perception	Active	Detects implants, skeletal biometrics, concealed weapons, radiation; penetrates walls and metal

for example, rely on the AI or software's Academics: Chemistry skill.

Hyperspectral Sensors

Also referred to as multispectral, full-spectral, and ultraspectral sensors, hyperspectral sensors receive input from multiple wavelength bands simultaneously and then compare the results against each other. The analysis of the input at different frequencies helps to identify features. Many objects and materials have unique spectral signatures across the electromagnetic spectrum, enabling easier identification when viewed with multiple frequencies at once rather than in just one band.

In game terms, hyperspectral sensors apply a +20 modifier to Perception Tests. Hyperspectral sensors are also good for defeating camouflage tricks or other circumstances that just impair perception at certain frequencies. Reduce the modifiers for these effects by half (for example, heavy smoke that impairs visibility by –20 is only –10 against a hyperspectral imager).

Enhanced vision and enhanced hearing bioware can all be considered hyperspectral.

Using Multiple Sensors

Sometimes simply having multiple perspectives on something can aid perception—this is one of the primary benefits of tacnets (p. 205, *EP*). At the gamemaster's discretion, analyzing the input from multiple sensor feeds may provide a +10 to +30 modifier to Perception Tests.

Surveillance

This section provides rules for many of the possibilities discussed in the Surveillance chapter.

Caught in the Act

Given the ubiquity of sensor systems, surveillance, and sousveillance, it is almost inevitable that *Eclipse Phase* characters will get caught on camera doing something illegal or questionable. This does not mean that alarms will trigger and security will immediately rappel down on every character that litters, pulls out a banned device, or acts squirrely. Even criminals and lawbreakers still have leeway to act in public, especially if they are smart about it.

There are many factors that may work in a character's favor. In older habitats or run-down areas, sensor systems may be decrepit, non-functioning, or prone to disruptions. They may get lucky and happen to be in a blind spot or area with very little coverage. They may be in view of sensors, but at a time when no one is watching, avoiding an immediate alarm. Or the voyeurs who happen to be watching may be distracted by the last minutes of their local sports team playoffs or simply may not care about the beatdown they run across when they have metacelebrities to stalk. Others may record what they see without alerting authorities, hoping to score some rep by releasing it virally—giving the characters get-away time, but creating complications later. The characters may also be acting in an area where the police have bigger problems to deal with or simply don't care, or they may be in an autonomist habitat where people stay out of each other's affairs unless somehow contracted or obligated to intervene.

Making It Random

Gamemasters that want to leave it to chance can make a roll whenever the characters break the law in public or otherwise do something that might draw attention. Take the lowest Moxie score of the player characters involved and multiply it by 10. Make a test using this as the target number. If the test succeeds, the event goes without drawing immediate attention/intervention. If it fails, someone has noticed. If it fails with an MoF of 30+, someone has noticed and triggered an alarm. The gamemaster can apply modifiers to this test based on the severity of the situation: +10 if weapons are visible, +20 if there is obvious illegal activity, +30 if there is major violence, –10 if in an area with light sensor coverage, –20 for bad neighborhoods, –30 is there is a major distraction elsewhere, etc.

Gamemasters should make sure to consider the circumstances when determining the response. A colony security AI might decide that suspicious activity is simply something to be flagged for analysis and investigation later, when more personnel or resources or available. A high-security hypercorp station is likely to respond to any unusual activity with more surveillance drones right away, if not active intervention. On an anarchist habitat, the local community defense collective may be alerted, bringing a mob of armed volunteers to investigate. On an Extropian station, a legal AI might be alerted to assess the situation, note anyone involved who has contracted with a security provider, and summon that contractor if the person is in need of aid. Other responses might activate vigilantes, local gangs offering community protection services, additional surveillance measures, live broadcasting via a media outlet, or more voyeurs in to view.

The Cost of High Reputation

Characters with very high rep scores (60+) tend to draw more attention. Any high-rep characters who are not keeping their public profiles hidden in privacy mode or who are visibly identifiable are more likely to be watched over by voyeurs. In this case, apply a +10 modifier for every 10 points of rep over 60 (+10 at 70+, +20 at 80+, +30 at 90+) when making tests to determine if activity is noticed.

What Sensors When

One challenge the gamemaster faces is deciding the type of sensors that happen to be covering a particular area at any given time. With so many sensor systems available, this can be a daunting

task. As a rule, cameras and microphones operating at standard wavelengths are ubiquitous and can be found in almost every situation. Beyond this, the types of sensor are quite often determined by the immediate environment. In large public habitat thoroughfares, infrared is likely to be available as well. In warehouses and storerooms, lidar will be used to track goods. In security access corridors and portals, electrical sense, infrared, and motion detectors are favored to detect anyone's passage. At major security checkpoints, x-ray, terahertz, and chem sniffers will be deployed. Along external approaches, radar, infrared, and seismic/ultrasound are used to detect approaching people and vehicles.

There are two main points for gamemaster to remember. First, any particular security system is likely to use the same technology throughout, both for cost purposes and ease of maintenance. Thus a habitat that uses t-rays and odor sniffers as access control in one area is likely to use the same sensor systems in most others. The same is true for private installations and residences. Second, gamemasters should tailor the situation for their players and their characters' abilities while remembering to mix it up. If the characters commonly use an invisibility cloak to foil cameras, throw them up against radar or seismic sensors once in a while.

Private Sensors

Sometimes the characters may be trying to track someone or something through available sensors networks. In these cases, the publicam networks may not always come through with the information or level of detail needed. At the gamemaster's discretion, however, private sensor networks seeded through public areas may provide the coverage desired. This is an additional expense (See *Private Sensor Feeds*, p. 154), but at the gamemaster's discretion, incorporating these additional networks into a search may apply a +10 to +30 modifier to Research Tests, depending on circumstances. Alternatively, the gamemaster can decide that the information the characters seek simply isn't available via public nets, and they must find the right private sensor feed instead (requiring a Research Test to locate the proper provider).

Private sensor networks have other advantages. Many cover areas that are off-limits to public sensors nets. Sometimes these are legit, such as land-owners who don't mind selling their private sensor feeds as a way of making some extra income or security services that cover private installations and sell exterior sensor feeds at their client's permission, giving them a cut of the take. Others are not legit: private sensor networks seeded by hackers or criminal syndicates, often hidden, that are sold on the black market at higher rates. Many of these private net holders are willing to deactivate their sensors or erase recordings if the offer is high enough.

Countersurveillance Tricks

These rules detail some of the tricks that may be employed to avoid or impair surveillance.

Mapping Sensors

Knowing what sensors are out there enables a character to devise countermeasures. There are many tools characters can deploy to map out the sensor coverage in an area: smart dust, lens spotters, electrical sense—not to mention just looking or pinging local wireless signals. In some scenarios, this may be treated as a puzzle by the gamemaster: will the characters deploy the right tech to find all of the sensors the gamemaster has planned out, or will they leave themselves vulnerable to a system they missed? In others, the gamemaster may wish to resolve this with a simple test to keep game play moving. In this case, have the character attempting to map out sensor coverage make an Investigation Test, applying appropriate modifiers based on the detection tools used and the sensors they are hoping to map. If successful, the character has mapped out the sensor coverage in a given area (for the time being!) and may even have located a blind spot (perhaps with an MoS of 30+).

Clearing Blind Spots

Sometimes defeating sensors is too risky. In this case, clearing a blind spot or route is an alternative option. As above with mapping sensors, the gamemaster can treat this as a tech-race puzzle or boil it down to an Investigation Test to locate and destroy them, assuming they have appropriate tools. Doing this without being recorded in the act can be challenging (perhaps requiring an Infiltration Test)—but this is also what bughunter bots (p. 157) and saboteur nanoswarms are for.

Avoiding Recognition

People wishing to avoid recognition of their morph can deploy a number of disguise modifications. Skinflex (p. 309, *EP*) and synthetic mask (p. 311, *EP*) are by far the best options, but sex switch, gait masking, skeletal masking, and chameleon skin can also be beneficial, as well as standard Disguise skill. If acceptable to local customs, a shroud (p. 151) provides complete personal anonymity. For biomorphs, one easy way to change looks is a simple hour in a healing vat for facial bodysculpting (p. 326, *EP*).

For those that want or have the opportunity to change their looks, there is one final option for avoiding facial recognition. The pattern-matching algorithms of facial recognition software are vulnerable to certain makeup or visual patterns (via chameleon skin), simply because the patterns foil their ability to make a match. Such makeup or patterns are visibly distinctive, however, and may arouse suspicion—though they are fashionable in some social circles, particularly among some media icons and celebrities that prefer to deter stalkers. When applying such makeup or patterns, apply a +20 modifier to Disguise Tests to avoid facial/image recognition.

Skipjacking

Skipjacking is the art of using Infiltration skill to time one's movements through a place that is under ubiquitous surveillance. This involves using other people, vehicles, and objects as cover, timing the movement of drones and cameras, and similar tricks to minimize one's profile and exposure to sensors—all while avoiding suspicion. Skipjacking is quite difficult to pull off, especially in areas with crowded sensor coverage, but it may at least prolong detection or add uncertainty. Treat this as a Variable Opposed Test between the skipjacker's Infiltration skill and the Perception of any monitors. Apply a –30 modifier to the skipjacker, perhaps less if the sensors are fewer or easier to avoid. If the skipjacker succeeds and the monitor fails, they avoid detection. If both succeed, the skipjacker has been detected, but not with absolute certainty.

Secure Communication

Outside of quantum and encrypted communication methods, there are a few ways for individuals to communicate face-to-face without fear of eavesdropping: skinlink, a wired connection between access jacks, or tight-beam laser links or hypersonic communicators.

Invisible Doors

One trick employed by criminal groups and others wishing to foil surveillance and physical tailing is to use so-called "invisible doors." These are physical gateways that use the same metamaterials as invisibility cloaks, literally bending light waves around the doorway. When strategically placed with crafty architecture, these can be made to look like a standard corner or alcove—only people can walk right through them. Others are cleverly turned to reflect light, making them look like full-length mirrors. In either case, these portals will not be physical to the touch. They can be detected with radar or x-rays, but are otherwise invisible to the rest of the electromagnetic spectrum.

Habitat Hacking

What follows are details for manipulating the most common and important habitat systems. The same rules may be used when working with the systems aboard large spacecraft, although gamemasters are encouraged to practice common sense in applying situational modifiers where the inherent characteristics of a ship differ from those of a habitat.

Airlocks

There are four sizes of airlocks commonly found aboard habitats, rated by volume in cubic meters. Standard airlocks are by far the most common size, large enough for two. Smaller airlocks are rare, partly to discourage people from going out alone, but occasionally can be found on large habitats as service airlocks for hab repair drones. Larger service and industrial airlocks are primarily found in docking or service bays. Airlock doors take one Action Turn to open and close, and 3 Action Turns or more to fill or evacuate with air. The *Airlock Sizes* table (below) shows the number of people who can fit in an airlock and the times each takes to cycle between opening and closing.

Airlocks have the same armor value and repair capability (if any) as the station's hull type (see *Hull and Superstructure*, p. 166).

Airlock Hacks

Because airlocks are so critical to the safety of transhumans in space, they're equipped with numerous safety features. To prevent tampering, most airlocks only provide identification and diagnostics via wireless interface. Operational features are either hardwired to a control panel or accessible only by physically opening a panel on the door.

Giving an airlock operational commands other than calling up diagnostics requires a Hardware: Electronics Test. This is Task Action with a timeframe of 2 minutes and allows the hacker to give the airlock operational commands without access or authorization for its control panel.

Physical airlock hacks require a Hardware: Industrial Test; this is Task Action with a timeframe of 2 minutes. This covers all actions that require overriding safety features, including disabling the lock's safety so that it can close on people or objects and blowing an airlock open without cycling.

Hackers may install a gray box (p. 150) in an airlock to create a remote back door as part of any of the hacking tasks described above.

AIRLOCK SIZES

SIZE	CAPACITY	VOLUME	CYCLE TIME (ACTION TURNS)	DEAR LIFE TEST	OBJECT BLOW	MOORING DV	DURABILITY
Small	1 person	2.5 m^3	2	—	5 kg	—	As Hull ÷ 4
Standard	2 people	10 m^3	4	SOM x 4	50 kg	3 DV/Turn	As Hull ÷ 4
Service	10 people or 1 small vehicle	30 m^3	6	SOM x 2	250 kg	5 DV/Turn	As Hull ÷ 3
Industrial	20+ people, multiple small or 1 large vehicle	30 m^3+	6 + 1/20 m^3 volume	SOM	2,000 kg	9 DV/Turn	As Hull ÷ 2

Basic Safety Features

Airlocks leading to and from pressurized areas work as normal doors unless a module is depressurized, in which case they kick in as airlocks (see also *Bulkhead Doors*, p. 166). Overriding a lock's pressure sensors is a physical hack (see *Airlock Hacks*, p. 164).

All airlocks have hardwired sensors that prevent them closing on people or objects passing through. Getting part of one's body caught in an airlock as it closes causes 3d10 + 10 DV and almost always results in dismemberment. Getting one's head, neck, or vitals caught in an airlock is certain death.

Blowing an Airlock

Airlocks can be forced to skip their cycling time. Doing so requires physically hacking the airlock. Typically this is performed on the outer door so that the contents of the lock (and possibly its occupants, see below) jettison rapidly. Effects of blowing an airlock vary based on its size. Blowing an airlock inward (i.e., opening a vacuum-filled airlock onto an atmosphere-filled hab corridor without cycling) produces only a loud bang, some ear popping, and possibly strong gusts that may toss small objects around (the latter only in the case of service and industrial airlocks). Blowing one outward (into space) can have much more dramatic effects.

When an airlock is blown outward, all of the atmosphere inside vents into space in half the time that would be required for the lock to cycle. In a small airlock, this has little effect other than possibly causing small, loose objects to fly out. On standard and larger airlocks, it creates a blast of wind. Characters must make a "Dear Life Test" to grab a hold of something or be blown toward the outer door (see the *Airlock Sizes* table, p. 164, for what to roll). They must continue to make this test each turn until the atmosphere is drained. Characters and objects blown out an airlock move at the rate of the airlock's cycle time x 2 in meters per turn. If a character fails the test, but their movement does not put them out in space, they may attempt another Dear Life Test at –10 to grab on to something else (but only at the gamemaster's discretion). If the habitat is filled with water or another liquid instead of a gaseous atmosphere, Dear Life Tests are at –30. If characters were forewarned of the airlock being blown and had time to find a handhold and brace themselves, the test is at +10. Characters who are restrained, unconscious, or otherwise unable to act are automatically blown out into space, though other characters may attempt to prevent this.

Large objects resist being blown out based on their weight and inertia. The maximum weight of object that a given airlock blow jettisons is given under the Object Blow column on the *Airlock Sizes* table, p. 164). Cargo nets and other moorings may prevent objects or characters attached with them from being blown out the lock, but the powerful air current produced when a lock is blown may strain them to the breaking point. Apply the damage shown under

Mooring DV each turn that a blow is in progress. This is not actual damage to the object, but tension that accumulates during the blow. If the DV exceeds the object's Durability, it breaks, and any objects or characters held by it are blown toward the outer door.

Opening Both Doors

Some airlocks, particularly on ships or stations with military damage control systems, are hardwired to their own private network of heat and carbon monoxide sensors, usually stretching a few dozen meters in either direction from the lock. If more than half of the sensors detect a fire, a device inside the airlock closes an air gap between the door's hardwired control interface and the rest of the ship's network, allowing crew to remotely open the inner door and blow the lock without cycling. This system is hard to fool, as doing so essentially requires setting an entire corridor on fire or digging deep into electrical conduits to find the wires for the fire sensors.

Personnel with authorized access to a lock's control panel can blow a lock automatically but cannot open both doors without the fire system or another override being engaged.

Airlocks in High Pressure Environments

The preceding rules are for airlocks operating in space or other low-pressure environments, where the pressure differential between inside and outside is one atmosphere or less. In the atmosphere of Venus, Europa's subsurface ocean (where external pressure can exceed internal pressure by 100 atmospheres or more), or other high-pressure environments, the effects are more dramatic. The gear and morphs employed by transhumans for survival in these environments is engineered to survive in them, but even it can't withstand an abrupt change in pressure. Anything inside an airlock in these situations will be instantly killed or crushed by an immediate change from inside to outside pressure, and the structure surrounding the airlock is likely to suffer catastrophic damage. In habs in the upper reaches of the Europan ocean or Venusian atmosphere, this most likely results in everything up to the next bulkhead being destroyed. On the Venusian surface or Europan ocean floor, this can result in the entire structure being destroyed.

For this reason, airlocks in these environments have only hardwired or even mechanical controls, as they would otherwise present far too tempting a target for saboteurs. Hacking or other tampering is extraordinarily difficult and should be impossible under normal circumstances. The most likely scenario in which an airlock failure would occur is from an explosion or other accident causing a major structural fault in the habitat.

Bulkhead Doors

A bulkhead door is simply half an airlock. Most habitats install bulkheads in strategic locations, so that segments of the habitat can be shut off or isolated in the event of depressurization, a biological outbreak, physical invasion, or other emergency scenarios. Bulkheads follow all of the rules for airlocks, minus the time needed to cycle air.

Hull and Superstructure

Hulls vary in composition and properties, from the composite alloy hulls of O'Neill cylinders to the thick silicate rock walls of beehives. Superstructure varies a great deal in design, as well. O'Neill cylinders, Bernal spheres, and toruses generally have sturdy metal truss-work underlying and supporting the hull material, although older designs might also have massive crossbeams running across the interior of the tube. Beehives and Cole bubbles, on the other hand, rely entirely on their thick rock walls for superstructure. Tin can habs are typically small enough that the hull is self-supporting, requiring little or no interior bracing.

Station hulls vary in how much damage they can take and how quickly (if at all) they repair themselves. This is summarized in a hull description, for example: Armor: 25/40, Wound Threshold 100 (Dumb). Armor for hulls works the same way as personal armor, canceling out specified amounts of energy or kinetic damage from each attack.

"Dumb" indicates the station has a dumb-matter hull. When needed, repairs are carried out with metals sheets and welders or with industrial-scale nanotech repair sprayers. Smart hulls require repair only in case of a catastrophic breach. Smart-hull stations that are poorly maintained or have recently suffered major damage (e.g., from an asteroid collision or space battle) may have sections of hull that were repaired with dumb materials and therefore do not self heal. Sections of dumb hull are a boon to both targeting analysts and infiltrators looking for a hull section through which to cut.

The Wound Threshold value shown is the amount of damage necessary to create a hull breach about a meter wide—big enough for most morphs to pass through without burning themselves on the edges of the breach. Also provided are guidelines for the overall superstructural integrity of a habitat. While big habs are almost impossible to completely destroy with conventional weaponry, smaller stations can be destroyed completely by large explosions or ship-mounted ordnance. A hull must be breached in at least one place before it begins to take superstructural damage.

Hull Breach

Gamemasters may use the rules for blowing an airlock (p. 165) to model the effects of hull breaches. Treat a standard 1-meter hull breach as a blown service airlock and larger breaches like a blown industrial airlock. Note that smaller breaches may become fully or partially blocked if a larger object (such as a desk or vehicle) is sucked up against them.

Smart hull self repair works at a rate of 10 damage points per hour. Damage that is larger than 3 wounds in size may not be repaired by self-repair systems.

LIFE SUPPORT

Life Support on a station or ship is the system that replenishes breathable atmosphere and filters it for impurities. In very primitive systems, life support is finite, consisting of tanks of fresh atmospheric gases. In *Eclipse Phase*, most modern-era systems can run almost indefinitely if regularly maintained and not interfered with by recovering and chemically altering "stale" gases.

SABOTAGING LIFE SUPPORT

Biological life support systems use organisms, such as algae, to metabolize waste CO_2 and release breathable oxygen. Sabotaging this type of life support system demands physical infiltration and is a slow operation. Such systems are often in their own modules or located along the exterior of a ship or station, close to the hull. If characters can do enough damage to punch through a ship or station's hull at one spot along each of the algae tanks in such a system, the medium inside vents into space, freeze drying the algae. After a breach, the atmosphere in the station will become unbreathable at a rate determined by the total volume of the system. A good rule of thumb is that it takes eight hours per thousand people relying on the system for the atmosphere to become unbreathable. Once this happens, it will remain so for 48 hours, until the system recovers with intake of recycled material from the greenhouse. (This assumes a self-repairing system; almost all are).

If a life support tank is attacked from inside the hull, tanks have an Armor Value of 50/50 with a Durability of 100. If hit with a hot round or energy weapon, they explode, but the explosion is directed outward, doing only superficial damage.

If the oxygen levels in a habitat are reduced or dangerous levels of other gases are added to the system, the inhabitants could be in trouble. See the section on *Alien Atmospheres*, p. 170, *Gatecrashing*, for advice on handling different atmospheres.

VENTILATION SYSTEMS

All habitats rely on ventilation systems to push and recycle breathable air. These ventways provide an optimal infiltration path for swarmanoids and similar small morphs. For larger transhumans, crawling through ductwork can be an ordeal (reduce Movement Rate to 2/4), or they simply might not fit. These spaces feature regularly spaced fans for circulation. To get past these, the fans must be disabled and removed with Hardware: Industrial skill. Larger fans cannot be removed, but can be stopped so that a character can pass through the blades. Many of these fans are monitored and alarmed, however, particularly at key junctions or leading into secure areas. Characters who are not careful can be injured in they stick their hands in or fall into a fan; apply 1d10 DV. Nanoswarms that attempt to move through a fan suffer 1d10 DV as well, possibly higher for larger fans.

Many ventilation systems possess countermeasures to deter the spread of harmful toxins or agents. The most common are ultraviolet cooking systems that roast any passing air, killing off biological pathogens. Others include nanofilter systems in which nanobots filter any

TYPICAL STATION HULL STRENGTHS

HABIT TYPE	ARMOR (E/K)	WOUND THRESHOLD	REPAIR TYPE	SUPERSTRUCTURAL INTEGRITY
Aerostat	60/60	200	Smart	20,000 per 1 kilometer length
Bathyscaphe	50/100	300–450*	Smart	500–750 per 5 meters diameter*
Beehive	150/200	1,500	Dumb	15,000 per 500 meters diameter
Bernal Sphere	70/70	500	Smart	15,000 per 500 meters diameter
Cluster	70/70	300	Smart	20,000 per 1 kilometer length
Cole Bubble	150/200	1,500	Dumb	15,000 per 500 meters diameter
Dome**				
Inflated	30/40	50	Dumb***	250 per 5 meters diameter
Structural	70/90	500	Smart	750 per 5 meters diameter
Hamilton Cylinder	150/150	1,000	Smart	30,000 per 1 kilometer length
O'Neill Cylinder				
<5 km length	50/70	450	Dumb***	40,000 per 1 kilometer length
>10 km length	90/100	750	Smart	80,000 per 1 kilometer length
Reagan	150/200	900	Dumb	30,000 per 1 kilometer length
Tin Can	50/50	100	Dumb	500 per 5 meters length
Torus	70/90	500	Smart	750 per 5 meters diameter

* Europan bathyscaphes have thicker walls than their counterparts on Ceres and Enceladus. Europan bathyscaphes also have higher superstructural Integrity. Bathyscaphes on Earth, if any still exist, are likely to have been retrofitted with heavier armor.

** For the dome itself; supporting walls should be treated as buildings (see p. 203, *EP*).

*** Older domes and O'Neill cylinders are generally dumb matter, lacking smart repair systems. However, the better maintained ones are sometimes retrofitted with smart hulls.

harmful chemicals or particulates from the air. Neither of these is dangerous to transhumans, and both can be deactivated and removed with a Hardware: Industrial Test (though they may be alarmed against tampering).

Reactors

Most large space habitats are powered by fusion or even fission reactors.

Sabotaging Reactors

Getting a reactor to melt down is extremely difficult, but determined hackers can do so, leaving a station to run on alternate power sources like solar panels and reserve power. This requires accessing the highly secured and usually hardwired reactor control network, and requires an Infosec Test at –30; this is a Task Action with a timeframe of 10 minutes. Gamemasters should specify how much reserve power a station has (12 to 24 hours is common for civilian stations).

Damage to a reactor's walls can have dangerous results. If a character discharges any kind of firearm or seeker near a reactor and misses their target with a Severe Failure (MoF 30+), their attack has struck and possibly damaged the reactor wall. Reactor containments have Armor 50/50, Durability 200, and Wound Threshold of 50. The containment area is self-healing (p. 292, *EP*). If it takes enough damage to exceed its Durability or suffers a wound, a superheated jet of plasma escapes the magnetic containment and burns anyone within 10 meters who fails a Fray Test (3d10 + 12 [28] DV, AP –10, resisted with Energy armor). The entire area is also flooded with heavy radiation (exact effects to be determined by gamemaster; see p. 201, *EP*).

Biological Systems

Habitat biosystems function like the components of massive biological bodies. They can be damaged, wounded, and poisoned, just like biomorphs. They are also self-healing at the same rate as biomorphs (p. 208, *EP*).

Organic Sensors

These sensors are vat-grown biological organs, mimicking enhanced biomorph senses (enhanced vision, enhanced hearing, enhanced smell). They must be attached to biological systems of nutrient feeding, sustenance, waste removal, well as a habitat cyberbrain (p. 174).

Habitat Infiltration

Getting onto or around a habitat without authorization is not easy, but for the determined many options abound.

Darknets

By far the simplest route to penetrating a station is to darkcast inside and use a black market body bank. Finding a darkcast connection into a specific habitat is usually the most difficult part, but the proper application of @-rep or g-rep can work wonders. Upon arrival, the darknet receiver can direct the newcomers to a black market morph provider (p. 277, *EP*). These illegal body banks are usually equipped to provide fake IDs as well as other ID-defeating tools, depending on local resources.

There is sometimes a risk in transmitting your ego via darkcast, but the darknet providers have their own reputations to maintain. In habitats where one group has a monopoly on darkcasting, problems sometimes develop.

Sneak Approach

Darkcasting isn't always an option. For those who don't want to test the reliability of their fake IDs or who don't want to put their egos in the care of habitat customs, the next option is to try sneaking into the station.

For stations on planets or moons, this is often not very difficult. Major dome and warren settlements on Mars, Luna, and Titan are used to traffic around the exterior of their habitats. Some don't even restrict entrance. Others feature local crime cartels who have already established underground tunnels or hacked airlocks in order to move contraband and so can offer to smuggle people in for a price. More isolated outposts, however, are likely to take an interest in strangers who drive up and start messing around outside their walls. With some preparation, however, it is usually not too hard to sneak up while evading sensor detection.

Habitats in space, however, are a different matter. Most are surrounded by thousands of kilometers of emptiness—a moat of vacuum that is perilous to cross. Sneaking up on a station without detection can be quite a challenge, as most keep an eye on their immediate environs with radar and infrared to spot the thrusting and braking of various drives. The latter is especially difficult, as any momentum that carries a ship toward a habitat must be arrested if the ship plans to stop there—and this means using drives that are a dead giveaway. For colonies on asteroids, the asteroid itself can sometimes be used to block line of sight for an approaching ship, though many stations deploy satellites that keep an eye on this angle as well.

Ultimately, all a potential interloper needs to do is to get close enough to the habitat to cross the void using an EVA sled or thruster pack. This can be accomplished by passing in the vicinity of the station and dropping the infiltrators off, by finding something nearby the station to hide a ship's deceleration behind, or by catching a lift some other way.

Aerostats and bathyscaphes are somewhat easier to approach. Any number of aircraft can be used to sneak up on an aerostat—microlights and balloons being particularly difficult to detect. There is also the option of skydiving down from an aircraft passing overhead—or even high-diving from space (see *High-Dive Suit*, p. 167, *Sunward*). Bathyscaphes, on the other hand, require swimming or using a vehicle that doesn't get noticed by the station's radar and sonar.

Catching a Lift

Potential trespassers don't always need to sneak across vast stretches of space to get to a habitat—there are plenty of options for getting close enough that individuals can sneak up on the station's exterior under the radar.

The easiest option is to simply take a ship that docks at the habitat, either legitimately or as a ruse, and then using the opportunity to sneak into space and over to the habitat. For colonies that deploy harvester drones, another option is to intercept one of these bots and use it catch a list back to the station's drone bay.

Exterior Access

Once at the habitat's exterior, an entrance can be found or created. This usually entails hacking an airlock (p. 164). Cutting or blasting one's way inside (see *Hull and Superstructure*, p. 166) is also an option, though this tends to draw attention with things like decompression and explosions. Some habitats, however, may have blind spots where breaching the exterior does not trigger alarms—careful research of a station's design might pinpoint these spots. Beehives or warren habitats, for example, might have unused or forgotten tunnels that lead to interior airlocks.

Anyone lingering on a habitat's exterior risks drawing attention. Many habitats keep security cams on their exteriors, overwatched by security AIs. These might be bolstered with infrared or other sensor systems. Particularly secure or paranoid stations may have seismic sensors built into the hull or may feature regular sentry bot patrols.

Workers on a hab's exterior are another obstacle. While these workers are not normally armed or trained as security guards, they will report the position of suspicious visitors to habitat security. The chances of workers being present on the exterior of a hab vary depending upon the size and type of the habitat. Big inner system habitats like Progress and Qing Long generally have active work gangs in synthmorphs out performing maintenance at all times. Smaller habs might only have work crews out during their day cycles. Work crews are somewhat less common in the outer system, where automation is preferred to indentures in synths. In the Jovian system, almost all exterior work is done by teleoperated bots due to extreme radiation. In other outer system habs, such as big clusters like Locus, spacewalking is very common simply as a means of getting around, so being spotted is much more likely—though, depending upon the situation, the observer might not even bother reporting the infiltrator's presence to anyone.

Interior Infiltration

Inside a station, the standard tricks for avoiding detection apply (see *Countersurveillance*, p. 39). An interloper that prefers to avoid public areas can attempt to take advantage of a habitat's infrastructure or service areas to get around. Many stations have service tunnels, venting systems, spaces dedicated to pipes and conduits, and so on. Though off limits to unauthorized personnel, forged credentials or clever hacking can gain access. The advantage to these areas is that they are far less surveiled, leaving a smaller footprint of records, and rarely traveled. On the other hand, any bots, workers, or security personnel are quite likely to regard an infiltrator they find here with suspicion.

Characters in small morphs—neotenics, hypergibbons, swarmanoids, etc.—have an advantage in that they can fit into and access infrastructure elements that regular transhumans can't, particularly ventilation systems.

Habitat Mesh Systems

The *Eclipse Phase* core rules provide details on many different ways hackers might subvert habitat security. Further information is provided throughout this section for gamemasters who wish to introduce more detail and realism to the process of hacking habitat systems.

Habitat Mesh Topology

As detailed under *Mesh Systems*, p. 81, there are simply too many habitat systems to condense into a single habitat control network—and too much information for a single intelligence to oversee. Instead, the various habitat functions are broken down into distinct mesh systems, each handled as a separate VPN with its own dedicated AIs and infomorphs. Many of these are broken down into further subsystems. Subsystems are almost always slaved to the master system in the hierarchy above them, meaning an authorized user on the master system can automatically access the slaved subsystem. Some systems retain an intentionally decentralized (or even factionalized) setup, while others are overseen by a master control network.

Every habitat is likely to have its own distinct network layout. Gamemasters expecting to run extensive encounters involving complex systems, especially on large habs, may want to create a map of mesh systems and the links between them, with notes on who controls or has access to what systems. A good system map will also show where important slaved devices are connected, and whether those connections are wireless, hardwired, or both.

Defining (Sub)Systems

At the top levels, each aspect of habitat operations is likely to have its own independent VPN. Though these vary, the following mesh networks are common: administration, defense, infrastructure, public service, resources, security, and spaceport. Many of these have a number of slaved subsystems, each their own VPN. Infrastructure, for example, could have hull, life support, maintenance, power, sewage, and water subsystems. Operations that eat up a lot of processor power (like running AGIs, infomorphs, egocasting, or simulspace) very likely have their own dedicated subsystems.

On larger habitats, each regional area of the station will have its own top-level network, with the various habitat ops serving as subsystems, or vice versa. On

OPTIONAL RULE: TMI (TOO MANY INTERFACES)

On large stations or habitats with an impressive number of active subsystems, scanning frequencies to find a desired subsystem or device might be complicated by the huge number of signals through which one has to sift. Gamemasters may apply a penalty from –10 to –30 on the Interfacing Test to find a subsystem or device in this situation. Stronger signals are easier to find, so physical proximity to the target system should reduce or negate this penalty. ■

smaller habitats, several systems might be consolidated if it makes sense to do so (e.g., defense and security functions might be consolidated, or spaceport systems might be meshed with infrastructure).

Mesh Nets and Entoptics

Users with authorized access to a particular habitat mesh network—or who have hacked access—can pull up an entoptic overlay of that particularly VPN's data as they move about the station. A user with access to the power network, for example, could get a visual overlay showing them where major power conduits lay, the location of nearby wireless power transmitters, power consumption rates of specific inhabitants/devices/services, and diagnostics on the solar arrays and reactors, among many other things. People with access to multiple networks can layer this entoptic information on top of each other. The same user with access to the life support mesh could compare the power feeds to different life support components or see what functions would be impaired if a certain power conduit was severed, and so on.

Access to a master control network, if there is one, provides entoptic overlays from many (if not all) of the subsystems. This is a powerful tool to have at one's disposal. Likewise, security mesh access grants the user access to sensor systems across the habitat—including many that are hidden from the public or that watch over private areas.

Redundancy and Backups

Accidents and disasters happen, systems occasionally fail. On a space habitat, this can be devastating. To counter this problem, almost all critical and major mesh networks have backup and redundancy options. Emergency power batteries can power critical networks for limited periods even in the case of a major power failure, and backup radio transceivers and wired systems can be brought online should existing systems be somehow taken down. Many mesh networks have the capability to take over the functions of a sister network should that network somehow become infected or damaged. The protocols for making this switch are closely guarded and often require authorization from multiple accounts.

Interfacing and Access

Habitat mesh networks follow all of the standard rules for security and intrusion as given in the *Eclipse Phase* core rulebook.

Wired vs. Wireless

When drawing up a system map, gamemasters should note which subsystems are accessible by wireless, which are hardwired, and which have redundant connections. Vital systems like life support, power grids, weapon systems, and the like are almost always hardwired and therefore can only be accessed physically. Locating hardwired access points for a given system requires a Hardware: Electronics Test. Profession: Habitat Ops or another relevant Knowledge skill may be used as a complementary skill. Modifiers for the Hardware Test should take into consideration how complex the habitat is, whether the character making the test is familiar with the system, and whether they have access to station blueprints, schematics, or the like.

Whether wireless systems are used in addition to hardwired links is a design choice, often reflecting how paranoid a system's designers were. Wireless controls for life support systems, for instance, are rarely used due to the extreme danger posed by sabotage. Similarly, critical spaceport systems, airlock safety controls, and the like rarely allow for wireless access. Weapon batteries are normally hardwired. However, on some stations, a wireless interface is installed that becomes active only if the battery's wired link to the fire control system is damaged. This is not an uncommon design choice, because hacking the backup wireless interface on a gun emplacement is generally impossible in the heat of combat.

System Security

Habitat mesh networks are almost universally set up as virtual private networks (p. 241, *EP*) using public key cryptosystems (p. 253, *EP*). This extra security makes them more challenging to hack (p. 260, *EP*). Oversight by AI, AGI, or infomorph monitors and security hackers is common place, especially essential networks.

Both master control networks and the core systems of major station equipment (particularly power, defense, and life support) tend to be very well secured. In many cases, this will include state-of-the-art or highly customized software, reducing the the effectiveness of exploit software (–10 to –30 on Intrusion Tests). For this reason, hackers often go after less-defended subsystems.

Station security admins vary in discipline and style. Some are human, while others are expert systems. Hackers might receive a bonus of +10 to +20 on Infosec Tests due to sloppy security administration or they might suffer penalties of –10 to –30 from such factors as many eyes on the system, skilled system design, or AGI admins.

Critical habitat communication channels are likely to be encrypted with quantum encryption on larger habitats.

Accessing Slaved Subsystems

Authenticated users on a master system almost always have access privileges to slaved subsystems. Accessing them takes a Complex Action, requires no tests, and bypasses both the firewall and active security. At the gamemaster's discretion, however, intruders with Hidden status will be downgraded to Covert status on the subsystem, as the intruders must pass themselves off as a legitimate user to access. Intruders who want to remain Covert can instead take the time to bypass the subsystem's firewall and active security (with a +30 modifier for having already rooted the master system).

On high-security systems, users with access privileges on master networks may still be required to re-authenticate themselves on slaved networks, but this is rare and an impediment to daily operations. Instead, standard practice is usually to safeguard only critical components, such as reactor controls, life support functions, defense emplacements, etc.

Each subsystem is its own system, with another level of slaved devices and subsystems. The higher up the chain one has authorization (legit or hacked), the deeper one can go.

System Hopping

Each system and subsystem within a station is considered separate for purposes of detection, intruder status, and other intrusion-related mechanics. Aside from master-slave network relations, some linked subsystems may grant access privileges to authenticated users of sister subsystems, particularly if their habitat operation focuses overlap. A custom officer with user access on the customs network, for example, may also have privileges to the local surveillance mesh, despite not having the rank to have access to the upper-tier security mesh network. In some of these cases, the user will have access but fewer privileges, meaning there will be less system operations they can conduct.

Hackers who have been detected (Spotted status) penetrating a system can exploit the differing levels of authentication by hopping to a different subsystem in the hierarchy—or even the master system. Monitors can attempt to track the intruder with an Opposed Infosec Test; they receive a +30 modifier to do so. If they fail, the intruder's status is upgraded to Covert following the hop. Hackers with Locked status, however, may not jump to another system in the hierarchy; because they have been detected, they will be locked out of linked systems.

Hopping between separate systems is handled as a normal intrusion.

Other Hacking Considerations

Mapping the subsystems making up a station's mesh is sometimes an important precursor to making Infosec attacks. Knowing which subsystems do what is obviously very important, but mapping out

HABITAT SYSTEM MAP: CENTRALIZED

This is a common system map for habitats with centralized mesh networks. Habitat subsystems are grouped here by function—the physical layout can vary greatly.

System is hardwired, not wireless

MASTER CONTROL NETWORK

ADMINISTRATION
Long Range Communications ■ Customs & Immigration (shared with Security) ■ Data Vault ■ Government Systems ■ Personnel Files

DEFENSE
Defense Satellites/Drones ■ Damage Control (shared) ■ Exterior Surveillance (shared with Security) ■ Fleet Tactical Network ■ Long-Range Sensors (shared with Space Port) ■ Weapons Batteries

INFRASTRUCTURE
Airlocks and Bulkheads ■ Damage Control ■ Structural Repair ■ Structural Status Monitors ■ Life Support ■ Maintenance Drones ■ Reactors ■ Power Grid ■ Smart Animals ■ Sewers ■ Water

PUBLIC SERVICES
Egocasting and Farcasting ■ Medical and Resleeving ■ Public Media Feeds ■ Public Nanofabbers ■ Simulspace Services

RESOURCES
Atmospheric Skimmers ■ Drone Bays ■ Harvester Drones ■ Mining Drones

SECURITY
Customs and Immigration (shared with Administration) ■ Detention ■ Exterior Surveillance (shared with Defense) ■ Customs and Immigration ■ Legal Services ■ Security Drones ■ Security Personnel ■ Smart Animals ■ Sensor Systems

SPACE PORT
Dock Services ■ Long-Range Sensors (shared with Defense) ■ Long Range Communications ■ Maintenance ■ Ship Resupply Feeds ■ Traffic Control

subsystem connections provides the added benefit of helping a hacker evade active security. This is a laborious process and can take weeks of effort. Depending on the circumstances, a standard mapping exercise should be handled as an Infosec Test with a two-week timeframe for small habitats and one month or more for larger. Having this knowledge on hand will help a hacker know where to look and where to go, without having to make Research Tests on the fly. At the gamemaster's discretion, a thorough mapping may also provide a bonus to Infosec Tests.

HABITATS AS MORPHS

Stations equipped with a habitat cyberbrain can be sleeved much like any other morph. While a single hab cyberbrain can possess and handle the input of a small tin can or similar station, larger habitats are too overwhelming. Instead, habitat cyberbrains are hooked up into a specific mesh system or subsystem, overwatching that aspect of the colony. Habitat cyberbrains have an advantage in that they are more difficult to hack.

SLEEVING INTO A HABITAT

Resleeving is a somewhat different process when the target body is an entire habitat, or even just a component system of one. Most habs are unique, meaning that individuals sleeved into them will have a variety of reactions. It is extremely rare for anyone to sleeve immediately into a station. Instead, there is typically an acclimation process where the individual "sleeves" into a simulspace model of the actual habitat and is then monitored by a psych team for signs of trouble. Sometimes this operation is carried out on a fork of the person to be resleeved rather than the original ego.

The experience of sleeving into a hab is much like sleeving into an exotic morph. An entirely new physiology and batch of sensory inputs awaits the ego, a completely different experience from standard biological and synthetic bodies. Habs that contain biological parts are a somewhat easier integration, as the presence of basic muscle and nerve responses contributes to the sense of having a body. The neural strata common to Hamilton cylinders and a few other habitat types are specifically designed to

HABITAT RESLEEVING DIFFICULTIES

These modifiers apply to both *Integration* and *Alienation Tests* (pp. 271–272, *EP*).

SITUATION	MODIFIER
Habitat is entirely synthetic	–30
Habitat has biological parts	–20
Habitat has neural strata instead of cyberbrain	–10
Small to medium habitat (less than 5 km length)	–20
Large habitat (greater than 10 km length)	–30
Ego is infolife	+20

behave like a biological mind and to interface with even non-biological components of the hab as if they were extensions of a biological body.

Sleeving into a hab imposes substantial penalties on the usual resleeving checks (see the *Habitat Resleeving Difficulties*, 172).

Attention and Perception

Habitat cyberbrains are physically plugged into the primary servers for a particular habitat mesh network. The ego admin level access on the entire system and on all slaved subsystems. In this situation, the ego perceives the manipulation of devices, the flow of data, and the input of sensor systems as sensory input. They effectively feel as if that mesh system and its physical components are their body. A door being opened may feel akin to twitching a finger, a change in power flow may seem like altering their breathing, a fire or damage to sensors may feel like pain or an irritating burning sensation, and so on. Being sleeved into a habitat does not make the hab ego omniscient or all-perceiving, any more than being in a transhuman morph would make one aware of all of the blood corpuscles, bacteria, and food particles moving through one's body. It does however confer a sense of proprioception: the sense of where all of the parts of their body are in relation to one another at any given time. The hab ego is always aware of the macro scale state of the system with which they are engaged, including such things as:

- Hull integrity
- Interior atmospheric pressure and rough chemical mix
- Exterior pressure (if in an atmosphere such as Venus)
- Position and overall functionality of major external "appendages" such as axial space docks or the mirrors and windows on an O'Neill cylinder
- Internal weather patterns and day/night cycles
- Nutritional state (for Hamilton cylinders)
- Overall biomass of inhabitants and service animals
- Overall rate of intake of power and raw materials relative to estimated needs from all systems
- Functional status of power grid, reactors, and life support systems
- Orbital position, orbital velocity, and position relative to other large objects (planets, moons, asteroids, other habs, and very large ships)
- Position and status of airlocks, bulkheads, elevators, and other portals and transportation systems
- Position and status of drones
- The status and activity of users on that mesh network

The ego is considered to passively monitoring these inputs at all times (meaning that they are immediately aware of any passive alerts triggered by intruders or similar alerts in other systems). The ego may perceive their interior and exterior from any available sensors. Because there is so much potential information on hand, however, the ego cannot realistically pay attention to it all. For most affairs, the ego can be considered to be distracted. To determine if they happen to notice a particular event, have them make a Perception Test with a –20 distraction modifier.

The ego can, of course, focus their attention, but they may only pay attention to as many tasks as they have active multitasking modules (plus one). The ego can focus on groups of events or sensory input, within reason, as limited by the gamemaster. A habitat ego could, for example, focus one of its multitasking actions on watching all of the sensors in a given room, tracking the power fluctuations in a given area of the habitat, or monitoring the communications of a group of approaching spacecraft for keywords.

Forking

Habitat cyberbrains are designed to be massively parallel and to facilitate advanced use of forks. All tests related to forking and merging are at +20 (+30 for neural strata). These forks are usually run on the system as infomorphs, and help to watch over specific activities or complete certain tasks. They are also used to sleeve into physical forms and interact with other transhumans as needed, merging with the alpha ego when they return.

Evacuation

Evacuating a habitat cyberbrain is not as easy or quick as jumping out of a standard cyberbrain as an infomorph. Since many of the habitat or mesh network's operations are routed through the hab cyberbrain, the absence of the ego could impair or disrupt ongoing operations. To successfully evacuate, the ego must first pass off functions to other components of the mesh system; this requires an Interfacing Task Action with a timeframe of 1 minute. Failure to follow these protocols could impair operations on that mesh system by as much as a –30 modifier for up to a minute as the system recovers (gamemaster discretion).

Muse

Habitat egos generally have a swarm of muses, normally one assigned to each major subsystem.

Discount Habminds

Some smaller habitats link standard cyberbrains to their setups, rather than specialized habitat cyberbrains. Normal cyberbrains don't have the architecture or I/O capability to keep up with the complex computing requirements of most habs. For any habitat larger than a tin can with a population of 50, a habitat ego sleeved in a normal cyberbrain suffers the following disadvantages:

- The ego has a stunted version of the usual habitat sensorium. Essentially, it can only choose to passively monitor one of the elements of the system at a time.
- The ego receives no bonuses on forking and merging.
- The ego does not gain any bonuses in repelling intruders (see below).

Overwatch Bonus

Habitat cyberbrain egos have an instinctual sense over the systems they are linked to. This gives them a distinct edge when combating system intrusion. Apply a +30 modifier for any Infosec Test by a habitat ego to detect, expel, or track an intruder on their system.

Habitat Cyberbrain Hacking

Habitat cyberbrains are vulnerable to cyberbrain hacking (p. 261, *EP*). In fact, this is one of the only ways a hacker has of defeating them. Unfortunately for habitat egos, since their cyberbrains are wired directly into the system's servers, they can be directly attacked by anyone who has already accessed that mesh network.

Like regular cyberbrain hacking, this process is quite difficult for the intruder: apply the standard –30 modifier. Habitat cyberbrains can be subverted just like any other system or cyberbrain. If the habitat cyberbrain is successfully puppeteered (p. 261, *EP*), the hacker gains full access to the system just like the habitat cyberbrain did—they effectively replace the ego.

If a habitat cyberbrain is disabled or shut down, there may be a temporary disruption as the system reallocates resources (see *Evacuation*, p. 173). The system will quickly recover and resume operations as normal.

Sample Habitat Morph

Every habitat cyberbrain/morph setup is different. The following provides an example which gamemasters can reference when creating their own systems.

O'Neill Cylinder Persona Core

Enhancements: Access Jacks, Basic Mesh Inserts, Cortical Stack, Habitat Cyberbrain, Mnemonic Augmentation, Multi-Tasking x 3, Oracles, plus sensory enhancements per habitat subsystems
Aptitude Maximum: 30
Advantages: +10 COG, +10 INT, +10 WIL
Speed Modifier: +2
CP Cost: Not available at character creation
Credit Cost: Expensive (minimum 100,000)

Habitat Morph Gear

The following gear applies to habitat cyberbrains.

Virtual Cyberbrain Software

This software creates a virtual cyberbrain on a system not otherwise designed to work with or act as a cyberbrain. Installing it requires security or admin privileges and is a Programming Task Action with a timeframe of 5 minutes. If successful, the software allows a single infomorph to run on the system much like a habitat cyberbrain. Virtual cyberbrains are not as secure as hardware cyberbrains. All cyberbrain hacking actions are at a +10 modifier. **[Moderate]**

Habitat Ops Server

Ops servers form the core of most habitat subsystems. A server is a massively parallel version of the standard personal quantum computer, with computing power equivalent to about 10 personal systems. Much larger, centralized systems were used on many habitats prior to the Fall, with the capacity of 100 or even more personal quantum computers. A few systems like this still exist, but they're extremely rare, as they're powerful enough to host a seed AGI. Few habitats will take this risk in the present day. **[Expensive]**

Habitat Cyberbrain

The cyberbrain of a habitat is orders of magnitude more complex than morph cyberbrains. Habitat cyberbrains are massively parallel and capable of running many forks of the core ego simultaneously, allowing the use of up to four multi-tasking modules (p. 307, *EP*) at once (although these must be purchased separately). Habitat cyberbrains are normally distributed systems, with processing nodes spread throughout the habitat so that damage to one area cannot take out the habitat's controlling ego. **[Expensive, Minimum 100,000]**

Hamilton Cylinder Neural Stratum

The mind of a Hamilton cylinder is considerably different from normal habitat ops servers. Composed of a layer of neural tissue spread throughout the hab, neural substrata, while lacking the raw factoring power of quantum computers, are capable of running even more processes in parallel than a habitat cyberbrain, suiting them well to simultaneously run numerous forks and multitask. The lack of innate quantum computational power is made up for by numerous small quantum computing nodes interfaced with various points along the stratum, but the ego gains the advantage of not being hackable like a cyberbrain would be. Attempts to crash neural strata, in the unlikely event that they're successful, only serve to temporarily deprive the mind of its hardware interface, not to actually damage it. Neural strata give the inhabiting ego a greater edge than cyberbrains in forking and merging, and they allow an inhabiting ego to control up to six multi-tasking modules (p. 307, *EP*) at once (as with a habitat cyberbrain, these must be separately purchased). **[Expensive, Minimum 500,000]**

Uplifts

The following rules and advice apply specifically to uplift characters.

Uplift Gear

Most gear designed for transhumans works perfectly well for uplifts (especially neo-hominids, neo-pigs, and neo-neanderthals). Some gear may require adaptation for an uplift's particular physiology, at the gamemaster's discretion. If a character is buying common gear in a major habitat or city, it can be assumed that uplift-modified gear is commonly available for no additional charge. Likewise, if the gear is nanofabricated, there are

likely uplift-adapted versions of the blueprints available. If the device is rare, however, or if the character is in some hole-in-the-wall brinker habitat, they may be stuck with using standard transhuman and either modifying it themselves (usually a Hardware Test using the appropriate field), suffering a modifier (usually –10, but higher if the gamemaster chooses), or going without (especially in the case of implants). Illegal and black market goods may suffer the same issues or it may simply cost extra given the rarity.

Uplifts and Drugs

Due to their different physiologies, drugs that affect transhumans may not affect uplifts at all or may have a drastically different effect. This is particularly true of neo-octopi and neo-avians. These differing effects are entirely up to the gamemaster. Note that even if a particular drug does not work on an uplift as it does a transhuman, there is likely a different version specifically designed for uplifts that does.

Smart Animals

The statistics given for smart animals in this book (p. 154) and others (p. 330, *EP*; p. 168, *Sunward*; p. 157, *Gatecrashing*) are for standard specimens. Many smart animals also come equipped with mesh inserts so they may be tracked, used as surveillance (viewing through their senses via the mesh link), or issued commands (usually issued in their owner's or trainer's voice in their heads). It is common to install a keeper AI (p. 155) in these implants as well, to provide extra oversight. A cybercortex (p. 148) is included by owners and trainers who want to squeeze more comprehension out of the animal's mind, and scent affinity bioware (p. 148) helps to keep them loyal. Some owners also give their animals basic biomods, increasing their health and extending the animals life. In some habitats, this is a legal requirement in order to minimize disease outbreaks. Clean metabolism bioware is also a favorite and sometimes required, especially in confined habitats where animal orders and sanitation can be a problem. Finally, puppet socks are also common, so that the critter may be manipulated as a biodrone (p. 175).

On top of this, many smart animals are given other specific enhancements as befits their function. Animals used for guard purposes, for example, are commonly equipped with bioweave, hardened skeletons, and reflex boosters or neurachem. Animals deployed for clandestine purposes may be given chameleon skin, grip pads, sensory enhancements, and oracles for better perception.

Not all implants available to transhumans are usable in smart animals. Some simply do not work with smart animal physiology, where others have never been developed for use in animals. The gamemaster has final call on what implants are available.

Smart animals can be equipped with cortical stacks (and can also be backed up and resleeved), though this is rare. Most owners still do not bother given the costs of the implants and procedures, but it is growing more common, especially for beloved pets. In some habitats, resleeving animals is illegal on the grounds that placing an animal mind in a new body it does not understand is cruelty, though this is challenged elsewhere. In other stations, resleeving an animal in anything but a morph of the same animal species is not allowed. Smart animals take quite poorly to resleeving (–30 on the Continuity, Integrity, and Alienation Tests) and especially poorly to morphs of different species (an additional –30).

Smart Animal Training

The rules for the Animal Handling skill provide some basic instructions for handling animal training (p. 177, *EP*). Smart animals can be taught to obey the usual range of simple commands: stop, sit, fetch, attack, intimidate, jump, hide, go home, etc. The timeframe ranges from 1 day to 1 week, depending on the animal in question. Smart dogs, cats, and monkeys take to commands quicker than other critters. More complex commands can also be taught: scout ahead, find specific object/smell/person, attack a specific target but not others, chase and corner but do not attack, go through the window, and so on. These take anywhere from 1 week to a month, depending on the complexity and the animal's affinity for the activity. A trainer can teach each animal a number of distinct commands equal to their Animal Handling skill divided by 5 (round down). Trained commands must be practiced over time or the animal will eventually forget them.

Biodrones

Smart animals with a puppet sock implant (p. 307, *EP*) can be teleoperated just like a robotic shell (p. 196, *EP*). These are a common tool for surveillance and reconnaissance purposes, especially on Mars or other habitats with free-range wildlife, using the inconspicuous morphs of local animals (native or pets) as a stealth advantage. Since direct communication links are too easily be tracked if not stealthed, biodrones are often ghostridden by an animal keeper AI or other infomorph who may also jam the pod. Being puppeteered is a confusing and scary affair for many animals, especially if the animal was placed in danger or a violent situation. This may cause the animal stress and may cause it to act confused, scared, hostile, or erratic afterwards. Many handlers implant drug glands with sedatives into smart animals that are regularly puppeteered to counteract this.

Subverting Biodrones

Like the cyberbrains of robotic shells, the puppet socks can be subverted by a skilled hacker (see *Cyberbrain Hacking and Puppeteering*, p. 261, *EP*). Since smart animals brains are biological, they are not vulnerable to entrapment, memory hacking, or scorching as cyberbrains are.

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